Sky and TELESCOPE

In This Issue:

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Cover setting ...
Mount Wils...

The Story of Two Atoms

THE STORY OF HELIUM is fairly familiar. First discovered in the spectrum of the eclipsed sun, helium was found terrestrially a quarter of a century later. In a recent issue of *Scientific Monthly,* Dr. S. Chandrasekhar, of Yerkes Observatory, reviews this story and contrasts it with the discovery in recent years of another two-electron particle, the negative hydrogen ion. This consists of an electron stably bound to a hydrogen atom, and its characteristics are, therefore, similar to those of the helium atom, which has in the neutral state two ring electrons.

That the negative hydrogen ion can be a stable atomic configuration was first conclusively proved by H. A. Bethe and E. A. Hylleraas independently in 1930, on the basis of quantum theory and wave mechanics. Most of the time the two electrons should be on opposite sides of the proton nucleus, one at a distance of 0.75×10^{-8} centimeters, the other at 2.02×10^{-8} centimeters, with the average angle at the nucleus between the two electrons being about 97 degrees.

Meanwhile, astrophysicists had been attempting to account for the distribution of energy in the solar spectrum, that is, to explain the relative intensity of the light in different colors. All efforts failed until in 1938 Dr. R. Wildt suggested that the negative hydrogen atom might be responsible for some of the absorption. In view of the high abundance of both neutral hydrogen atoms and free electrons in the solar atmosphere, the existence of negative hydrogen ions seemed highly probable, and the problem is now solved satisfactorily.

Dr. Chandrasekhar and his co-workers first determined the expected absorption characteristics of the negative hydrogen atom. Then they were able to show that the presence of negative hydrogen ions explains the difference between the observed energy distribution in the sun and the distribution to be expected on the assumption that the absorptive power of the sun's atmosphere is independent of color. Thus the negative hydrogen ion has been found spectrophotometrically in the sun from previous theoretical work.

The Yerkes astronomer concludes with the comment that this story has a plot in some respects the reverse of the earlier helium story, for while helium was first found in the sun, the stable existence of the negative hydrogen ion was first proved theoretically and it was discovered in the sun 15 years later. Both stories have, however, the same moral, enunciated by Sir Norman Lockyer in his story of the discovery of helium 50 years ago:

"The more we can study the different branches of science in their relation to each other, the better for the progress of all sciences."

DORRIT HOFFLEIT

Sky and TELESCOPE

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CHARLES A. FEDERER, JR., *Editor*; HELEN S. FEDERER, *Managing Editor*

AN ECLIPSING BINARY OF UNUSUAL INTEREST

In Coma Berenices, the star known as Alpha or 42 is a visual binary with a period of 25.87 years. Its component stars are practically identical, of magnitude 5.2 and spectral class *F*5. Acting upon a suggestion made by L. Rosino in an Italian publication, Dr. Luigi Jacchia, of Harvard College Observatory, finds this star to offer the interesting possibility of the eclipse of one component by the other about the middle of November, 1948, when the angular distance between the components should be reduced to only 0.0022 seconds of arc.

But at their distance of about 50 light-years, these stars, if each is about the same size as the sun, should have apparent diameters of 0.0006 seconds, which makes the chances of eclipse seem not too favorable. Nevertheless, Dr. Jacchia believes it will be well to watch this star system very carefully at that time for fluctuation in its total light caused by the possible eclipse. The change of light may last only a couple of days and might be very small, so observations with sensitive photoelectric cells are desirable.

As Dr. Jacchia points out in *Bulletin* No. 5 of the Panel on the Orbits of Eclipsing Binaries, where his note appears, in November of 1948 42 Comae will be only briefly visible in the morning sky. But in 1963, about April, another similar event is scheduled, with the minimum separation of the components only one third as great and with Coma Berenices in the sky almost all night.

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CONTENTS

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The Fifth National Convention of Amateur Astronomers, photographed by Gladys Muller in the chamber of the Fels Planetarium, Philadelphia. Seated in the front row are, left to right: Charles A. Federer, Jr., national vice-president-elect, Amateur Astronomers League; Edwin F. Bailey, in charge of the convention exhibit; Dr. Harlow Shapley, temporary national president; Edward A. Halbach, national president-elect; Mrs. Margaret Back, national secretary; James B. Rothschild, executive secretary; Mabel Sterns, temporary national treasurer; Armand N. Spitz, chairman, convention committee; Dr. Samuel G. Barton, University of Pennsylvania. Franklin Institute photo.

CONVENTION AT PHILADELPHIA

By Margaret Back, *Detroit Astronomical Society*

ONCE AGAIN the happy family of amateur astronomers has met and once again has parted. The fifth annual convention is over. To those who were prevented from attending by human entanglements, we extend our sympathy and the hope that they will begin right now to mark off the dates of July 3, 4, and 5, 1948, to be spent in Wisconsin at the invitation of the Milwaukee Astronomical Society. This welcome prospect was presented to us by Edward A. Halbach, who is now national president-elect of the Amateur Astronomers League.

The most telling phrase given to the assembly in the lecture hall of the Franklin Institute was that of Dr. Harlow Shapley, our temporary president, when he announced briskly, "This is a historic occasion." Another phrase that bound us together came from James B. Rothschild, now our executive secretary, as he reminded us that "an organization is no stronger than the strength of each unit." And at this convention each individual amateur attending had opportunity to take part in laying a solid and workable foundation for a league which keeps on growing in size and usefulness.

The Franklin Institute is one of Philadelphia's finest educational institutions, devoted to bringing to the layman the facts of theoretical and practical science, and employing an abundance of working models and exhibits, including, of course, the famous Fels Planetarium. The weather combined with the natural charm of the City of Brotherly Love to fulfill every requirement that a convention of various grades of astronomers, humble and great, could possibly desire. The program arranged was all that could have been hoped for — no idle moments were enjoyed by anyone. During the reports from societies, all were busy making mental notes for serious improvement and practical expansion of their local activities.

Early on the agenda of the temporary council was raised the important point as to whether or not the name of the Amateur Astronomers League should be altered to one which would be more acceptable to every class of astronomer, leaving the door wide to the lowliest and the highest alike, with no possibility of imagined barrier to groups or individuals. Discussion pro and con ended in a resolution to propose deleting the word *amateur*, but on further discussion of this matter in the general session on Sunday morning, F. H. Cox, of Norfolk, Va., supplied the brilliant solution which satisfied one and all present. His proposal was the name *Astronomical League*. At an early date, all of the member societies will receive for ratification this change and other amendments to the by-laws.

On Saturday afternoon, at a business session, voting for the four national officers who will take office on September 1, 1947, was a scene of lively interest, as delegates representing 23 of the 31 member organizations stepped forward to the desk four times with their written ballots. Chief teller William C. Oberem, of Buffalo, N. Y., along with fresh relays of assistants, called the result of each vote. Mr. Halbach was the choice of the assembled body as national president. Charles A. Federer, Jr., was made national vice-president; the writer, national secretary; and Carl P. Richards, Salem, Ore., national treasurer. Mr. Rothschild's appointment as executive secretary had been previously made by the temporary council, in accordance with the by-laws. As the

The Network (Veil) nebula in Cygnus, taken with a 10-minute exposure by Dr. Henry Paul with his f/2.0 Schmidt camera.

delegate from the present one region of the league, the council chose Neal J. Heines.

For these elections, Mrs. Helen S. Federer, Bond Astronomical Club, Justin F. Rennilson, Eastbay Astronomical Association, and George L. Skirm, National Capital Astronomers, comprised the nominating committee, while nominations were also received from the floor.

Directly from Washington, Dr. Shapley brought a timely invitation from Watson Davis, director of Science Service, to furnish headquarters' space and facilities in the expanded home of that organization, which has recently acquired a building adjoining its well-known location. Thus 1719 N St., N. W., Washington 6, D. C., may now be taken as the address of the AAL and of our executive secretary. In addition to the numerous duties usual to his office and those assigned to him by the by-laws, Mr. Rothschild will establish at the earliest convenient time a program information bureau; he is also authorized to distribute to member organizations an executive secretary's bulletin.

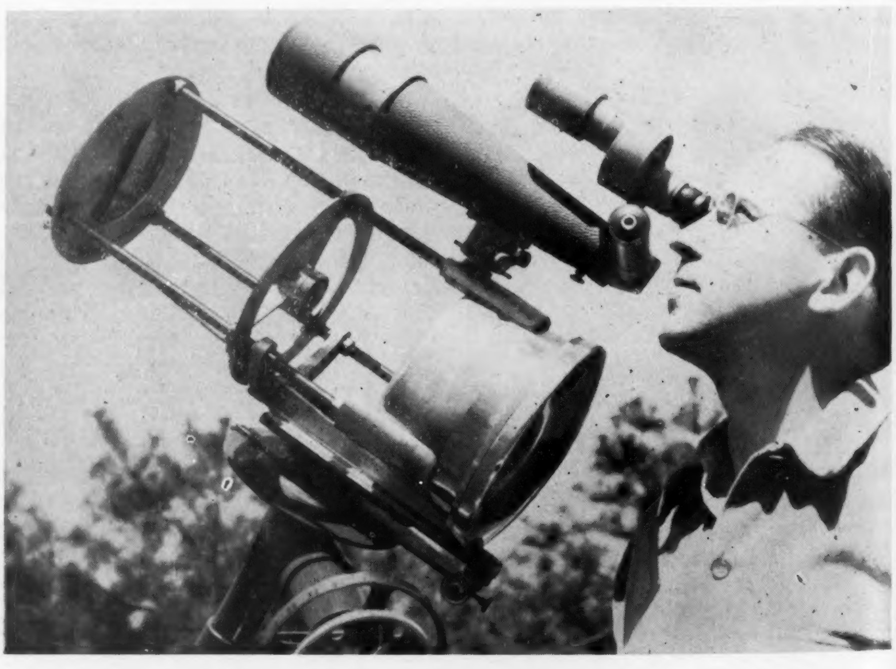
Telescope making came in for some lively discussion Sunday morning. Richard Luce, of the optical division of the Amateur Astronomers Association, New York City, presented a paper by Harvey E. Parry which described a "mass-production" method of producing telescope tubes and mountings. Thirteen amateurs who had completed mirrors in the Hayden Planetarium combined their resources and took advantage of shop facilities provided by Stuyvesant High School. They established a policy of "no substitutions," and produced 13 instruments based on the design of Allyn J. Thompson. At the close of his talk, Mr. Luce was asked by many ATM's present to inform amateurs more generally of the availability of his standardized castings and parts for telescope mountings. He may be addressed at his home, 168 - 73rd St., Brooklyn 9, N. Y.

Another talk on telescope making and observing was given by Dr. Henry Paul, of Norwich, N. Y., entitled "The Amateur's Schmidt Camera." He discussed the factors an amateur should consider in designing a Schmidt camera, and pointed out that the Schmidt marks the first time in history that a high resolving-power, wide-angle lens design falls within reach of the average telescope maker having workshop facilities. For *average* sky work, a Schmidt should not be too fast, since sky fog limits the ability to photograph dim stars. Dr Paul recommended an f/ratio from 2.0 to 2.8 for all-around work, although for meteor photography higher apertures are very desirable.

"Too small a camera, lacking resolving power, should be avoided," stated Dr. Paul, "while too large a camera may become a white elephant to the amateur as a result of its physical size and weight. An optimum size would seem to range around a 7-inch clear aperture correcting plate (from glass only one quarter of an inch thick) combined with a mirror 10 inches in diameter, 28 inches radius (14-inch focus), to give an f/2.0 camera. The filmholder should be about 2½ inches in diameter to cover an angle of 10 degrees. Correcting plates should be thin, but for plates greater than eight inches, amateurs may have trouble with flexure Such a camera will provide beautiful 8 x 10 sharp enlargements of many of the wonderful objects in the sky too dim to be seen with the eye, such as the Network nebula in Cygnus."

Other papers devoted to observing matters were by Paul W. Stevens, Rochester, N. Y., "Eclipses and Occultations," and by Mr. Heines, "Amateurs Patrol the Sun." Mr. Stevens described some of the theory which has already been discussed in his article in the May, 1947, issue of *Sky and Telescope*. There it was shown that in the present century Jupiter is often seen near the sun during a central solar eclipse, but it is never seen near the moon during a total lunar eclipse. This unique relationship, however, does not apply to the other superior planets. They may be observed close to the moon during either type of eclipse a number of times in the 20th century. Mr. Stevens also discussed the occurrences of occultations of the Pleiades and their positions near the eclipsed sun and moon. During 1950 and 1951, occultations of the Pleiades will be frequent.

Prior to the war, sunspot observations in the United States were made mainly at Mount Wilson Observatory, the Naval Observatory, and at Mt. Holyoke College; also by the late H. Helm Clayton, Canton, Mass., Mrs. William Kearons, West Bridgewater, Mass., and Mr. Heines, who is a resident of Paterson, N. J. From worldwide observations, the relative sunspot numbers were determined at the Federal Observatory of Switzerland at Zurich, the headquarters of sunspot statistics, so appointed by the International Astronomical Union. But the war caused disruption and termination of the Zurich numbers, making it necessary to find observers to furnish Washington with sufficient current sunspot data. The AAVSO then requested Mr. Heines to form a large observing group, as the data from only four sources was not



A Schmidt camera with 5-inch correcting plate and 10-inch mirror, built by Dr. Paul. The covering of the tube has been removed to show details. The refractor is a guide telescope.

sufficient for accurate computation of the relative sunspot numbers. This solar division now has 60 observers, supplemented with an affiliated research section of some 20 persons, and up to May 1, 1947, had submitted to Washington 16,628 observations.

Solar division data enables the Central Radio Propagation Laboratory at Washington to compare sunspot activity with disturbances in the ionosphere and in the earth's magnetic field.

C. M. Cannaday, of the Indiana Astronomical Society, described a method he has devised for locating constellations. The sky is divided into 12 "roads" extending from pole to pole and each corresponding to one constellation of the zodiac. The roads have stations on them for constellations and stars, and the approximate right ascensions and declinations are used to designate the stations. Thus Orion is at station 6R-0, Leo 10R-20N, Vega 18R-39N. Road 24 (Pisces) contains Cassiopeia, Andromeda, Pisces, Cetus, Sculptor, and Phoenix, as well as other groups. Mr. Cannaday pointed out, "If an amateur knows his zodiacal groups forward and backward the north and south constellations fall naturally into place. A few trips over each road should enable one to remember easily all the stations on the run."

A paper on the subject of the surface temperature and atmospheric conditions on Mars was presented by James P. Dow, of the A.T.M.'s and Observers of Buffalo, N. Y. He concluded that Mars has a considerable atmosphere, but is subject to large extremes of temperature even though it is farther from the sun than the earth is. Dr. T. D. Cope, of the University of Pennsylvania, reviewed the interesting story of early surveying near Philadelphia in his paper entitled, "Mason and Dixon Were Astronomers."

By request, Dr. Shapley gave an impromptu talk on the Schmidt camera and its more advanced forms. Later, the convention adopted a resolution of appreciation to the Harvard astronomer for his inspiring leadership and serious work as temporary national president of the league. He was asked to form and to be chairman of the technical advisory council, to consist of both amateur and professional astronomers, who will be invited to act as consultants to the activity sections of the league. The first of these sections to be formed is one on lunar and planetary observing, this as a start in league co-operation with the recently formed Association of Lunar and Planetary Observers, which has its headquarters at the University of New Mexico. An instruments section was also established, to combine activities on the making and use of telescopes and other astronomical instruments.

Just about the time discussion of the place for the 1948 convention was under way, the following telegram was received: DARLING ASTRONOMY CLUB ACCEPTS BY-LAWS. APPLIES MEMBERSHIP. LETTER WITH FEES FOLLOWS INVITING NATIONAL CONVENTION DULUTH FUTURE DATE. INVITING FIRST REGIONAL CONVENTION. SUGGESTING SUMMER 1948. Thus the Darling Astronomy Club, of Duluth, Minn., became the 32nd member organization of the Amateur Astronomers League.

Already, at the opening session on Friday morning, Mr. Federer had pointed out the rapid increase in the number of astronomical groups since the close of the war. His wall chart showed some 90 American societies, including the 11 centers of the Royal Astronomical Society of Canada. He proposed the division of the United States into eight regions or more, and this proposal, with modifications made during the council and convention sessions, will be passed on to the member organizations, in whose hands lies the establishment of the regions themselves.

An important announcement was that of the dues for members-at-large — those individuals who wish to join the league directly. The dues were set at three dollars annually, with one dollar initiation fee. Armand N. Spitz, congenial chairman of the host convention committee, and director of education at the Franklin Institute, became the first member-at-large.

It was Mr. Spitz who clung to the last thin hope and won out when a near "tragedy" happened at Sproul Observatory on the evening of July 4th. The entire party was on hand near the scheduled hour hungrily awaiting the picnic supper which was nowhere in sight. Finally, after sightseeing on the Swarthmore campus, the group was led to the beautiful Scott outdoor amphitheater by Mr. Spitz and Dr. Peter van de Kamp, director of Sproul Observatory. A chilling hush fell, for all hope for food that evening was now considered to be abandoned, and we thought to try the maxim, "Fast, fast, who with the gods would feast." Mr. Spitz began to explain the difficulties of feeding 150 persons including many late registrants on a holiday of such magnitude, when suddenly Dr. van de Kamp, with dramatic timing, spied the truck bearing the long-awaited food.

The picnic in the Scott amphitheater, Swarthmore College. Photo by Paul W. Stevens.

The Sproul instruments were examined, and though observing conditions were not perfect, many enjoyed looking at Jupiter through the long-focus 24-inch refractor, after greetings had been extended by Dr. van de Kamp.

After the banquet on Saturday evening, the buses became lost on the way to the Strawbridge Observatory of Haverford College. They gave very full value for the dollar charged for the round trip on this occasion. But no one cared this time, for the delightful banquet had been safely partaken of in the stately Franklin Hall of the Institute, watched over by the imposing statue of Benjamin Franklin himself, and near the Institute's Foucault pendulum. At Haverford, there was plenty of time to be greeted by Dr. Louis C. Green, the director, and to see the instruments. Everyone also attended a continuing lecture and demonstration by Mr. Spitz of the newly installed Peerless Planetarium at Haverford. Amateur astronomers turned the cranks and handles of the instrument themselves and made imaginary planetarium trips north and south, east and west.

Each person who registered at the

(Continued on page 24)

The author's globe of Mars showing many of the principal features of the planet.

Making a Globe of Mars

By John Sternig, *Science Counsellor*
Public Schools, Glencoe, Ill.

MARS will again come into the evening sky later this year and will be eagerly studied at its opposition in 1948. Observations of the planet are always more interesting if they can produce some tangible results. During the opposition of 1946, the writer observed much detail with a small 3-inch refractor, enough to allow a series of drawings on which the individual features could be identified. However, to do this one must have some means of identification. Maps are available, of course, and may suffice for some folks. But many amateurs are enthusiastic enough to want to go beyond that. For them this article describes how to make a globe of Mars, which is a practical project and result in a useful and unusual model.

First procure an old globe of the earth. The attic may have one hidden, or a secondhand store may supply one for a very small price. Sometimes th local school may have some old worn out globes which are ready to be junked

The first step is to groove the lines of longitude and latitude into the surface with a sharp knife. These are al ready on the globe at 10- or 15-degree intervals and are simply cut into the surface. The purpose of the grooving is to keep the co-ordinates showing after the globe is painted. They are essential later when it comes time to draw Martian features on the globe.

Next, the globe is given several coats of flat paint, enough to hide completely the original earth features. The paint should be pale red or ochre in color, made by mixing a little red and brown with flat white paint. When the paint is dry, use fine sandpaper and steel wool to remove brush marks and to prepare the surface for drawing.

Now the real job begins. Number the lines of latitude and longitude. Remember, you go from 0° at the equator to 90° at the poles, and from 0° at the prime meridian eastward (counterclockwise as seen from the north) for 360°, which brings you back to 0. Martian longitude does not stop at 180 degrees to give east and west longitude as it does on the earth.

With the co-ordinates located, you can begin on the features. Good maps of Mars are needed. It is the writer's experience that there is no single map which shows everything, especially in the polar regions. Therefore, the following sources are suggested:

The books *Mars, Mars and Its Canals, Mars as the Abode of Life,* all by Percival Lowell; Volume I of *Splendour of the Heavens,* by Phillips and Steavenson; The SKY, July, 1939, and October, 1941; *Sky and Telescope,* November, 1941, and April, 1942; and *Popular Astronomy* for June and July, 1926. There are undoubtedly other sources but the writer found these were enough. They may be obtained from the local library in most cases.

Once the references are at hand the following procedure is recommended. Make two large circles, one for each hemisphere, on a piece of paper. Put on them the lines of latitude and longitude in the same intervals as on your globe. Most Mars charts are made with 10-degree intervals. If your globe has 15-degree intervals you will need to use care not to become confused in the transposition.

Put the Martian features on your map by the system of "squares," copying section by section what appears on the original maps. Once your flat maps are complete you are ready to put the features on the globe, which is also done section by section. There will be, of course, some change in appearance of the features, especially when rectangular,

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Mars Through a Telescope

A trembling red ball, burning in blue
space,
Dim ghosts of continents dark on its
face,
A point of polar cap that glistens white,
The telescope's clock clicking in the
night.

Walter W. Stephen

Mercator-type projections have been used for the original maps. As the meridians on the globe converge toward the poles, features within them naturally compress. Actually, they will be as they are on the planet; it is the flat maps which are distorted. For the polar regions, it is best to use some of the polar views given in the Lowell books.

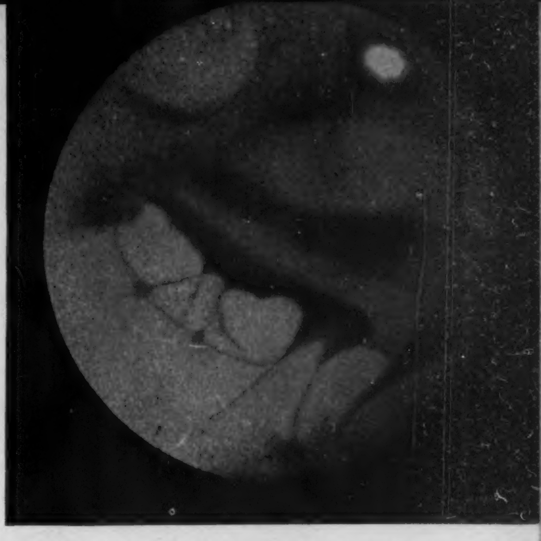
Once the features are drawn on the surface they are painted. The dark regions are blue-green; polar caps are white; "canals" are simply lined. Lowell's book, *Mars and Its Canals,* has some beautiful color plates which will serve as guides in painting the details.

The names of the various areas are then lettered in with India ink. After a double and triple check to see that nothing is left off, the whole globe can be varnished to prevent the names from smearing when cleaning is necessary. At this point, if the globe is carefully made, it becomes an interesting addition to the library or den. But its greatest value comes when it is used to identify features on the real Mars.

Perhaps some remarks on observing are in order here. Drawings made at the telescope are often hard to identify, since the average small telescope does not show, or the observer does not see, all the details shown on the globe. Therefore, it is important to orient one's drawing to the globe by knowing the central meridian of Mars at the time of observing. This can be located on the globe and comparison made with the drawing.

The central meridian of Mars is given in the *American Ephemeris and Nautical Almanac* in the section entitled, "Ephemeris for Physical Observations of Mars," where is included much other information of use to Mars observers. The position of the central meridian is given for Greenwich at 0^h, which corresponds to 6:00 p.m. Central standard time of the previous date. The meridian for any hour of the evening can then be found by adding to the meridian given 15 degrees (approximately) for every hour past 6:00, or by interpolating in the table if more than a few hours difference of time is concerned. For instance, suppose you plan to observe at midnight, CST, on December 18th of this year, which corresponds to 6:00 GCT, December 19th. The *Ephemeris* gives $14°.96$ as the central meridian for 0^h, so that for the time of observing the central meridian should be about $105°$. Interpolation in the table gives, however, a more accurate value, $102°.63$; this results from Mars' rotation period being somewhat over 24 hours.

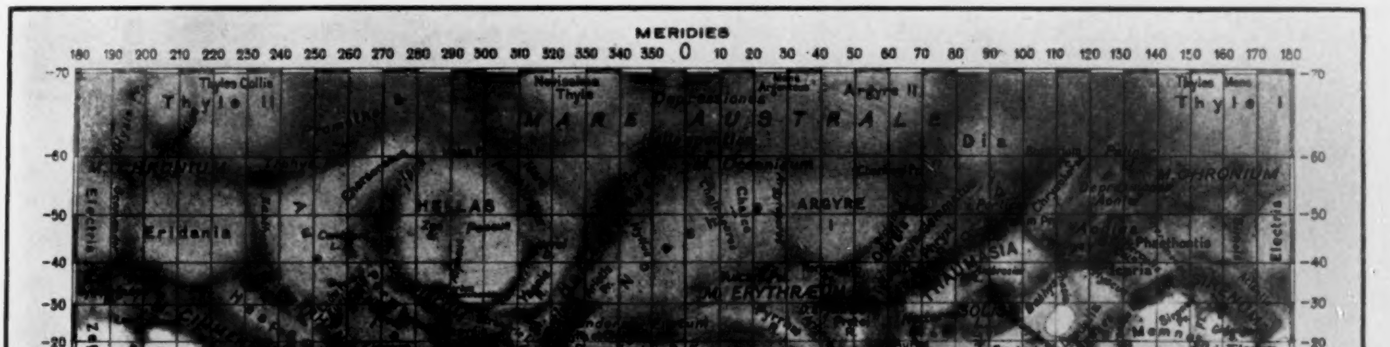
The *Ephemeris* also gives the planet's distance in astronomical units for every day. Furthermore, the date of the Martian season can easily be determined by looking up the planetocentric longitude of the sun in these same tables, and then converting that into the seasonal date by referring to the sun tables under the corresponding longitude. For instance, on December 18th, the sun's planetocentric longitude for Mars (measured from Mars' vernal equinox) is $32°.41$, which corresponds to the sun's longitude as viewed from the earth about April 24th. Therefore, the



This drawing of Mars shows the region of Sinus Sabaeus central on the disk. It is one of the famous drawings of the late E. M. Antoniadi, French student of Mars and other planets.

Martian seasonal date that night will be April 24. It is interesting to know this in connection with the changes in the polar caps. Be sure to note that in a telescope the planet is inverted, with south at the top. The *Ephemeris* tables also give the position angle in the sky of the axis of rotation of the planet.

The writer finds that even a small telescope shows enough detail on Mars in the month preceding and following opposition to allow drawings which show the main features. Anyone who makes a globe of Mars will have new interest and stimulation for carrying on a regular observing program when the planet returns to our evening sky late this year.



A general map of Mars, one of those to which the author makes reference. It embodies Antoniadi's observations with the 33-inch refractor of Meudon Observatory from 1909 to 1937.

Star Trails and Photographs

With modern equipment amateurs can do excellent work in photographing the night sky.

These star trails were taken by Francis E. Rowe with an f/3.5 Voigtlander camera. In the upper right are the Pleiades; in the lower left the Hyades. As panchromatic film was used, Aldebaran, an orange star, appears of the correct relative brightness.

I HAVE ALWAYS been interested in astronomy but am only now getting a toehold. My brother, Jerry, and I are planning a 10-inch reflector on which we will resume work shortly. But during the winter I have spent many hours experimenting with stellar photography.

Back in January, 1946, I had the good fortune to visit Mount Wilson and learned first hand of some of the operations of the observatory. It was a very mild evening that Saturday, so I set up my camera after midnight and took the picture of Orion streaking behind the 150-foot solar tower (see the front cover). The exposure was 90 minutes at f/2.9 with a flashlight shining on the tower for part of the exposure.

During last summer my brother Jerry and I worked on our 10-inch mirror without much success and took pictures of noncelestial objects when the sun shone. In the fall, I dusted off the simple equatorial mount Jerry had made a few years before and started taking time exposures of the stars. After many exposures with a fogged lens, I constructed a paper lens shade and wrapped resistance wire around it, connecting it in series with a small light bulb.

The essential elements of the equatorial were an electric motor which turned once a minute and parts of an old sextant. But the mechanism requires resetting after 45 minutes running. We have a small camera mounted parallel to a 2-inch refracting telescope of 45 power, and correct slight deviations in the drive by pressure on the leg of a wooden tripod which supports the equatorial. The apparatus is directed at the north celestial pole by means of a simple telescope fastened in line with the ½-inch shaft of the equatorial, and equipped with crosshairs so that we may offset it one degree in the proper direction.

Not having a star atlas, I located Uranus by taking pictures on three different nights. But my small camera didn't give much separation of star images, so I got a 12-inch focal length binocular lens of speed f/4. The two cluster prints enclosed herewith, of the Beehive and M35, are taken with this. Guiding on a 5th-magnitude star is quite a task with our equipment.

By the time I was really set up for pictures with the binocular lens, the Andromeda nebula was rather low over the city. But I took one picture for half an hour one evening, and was thrilled because it was the best shot we had gotten of anything. Next fall we will get some that will make this one look very poor. Actually, the lens is in focus for only a small portion of the negative.

Then, while the moon was up to interfere with our stellar pictures, we got out the 10-inch mirror, which had been polished for a half hour from the next-to-last stage of grinding, and took a few pictures. Without silvering, there was barely enough light to get a detailed picture on fast film at the focal plane. But with the sun we had the opposite problem — how to cut out enough of the light to get a picture. We solved the problem by stopping the mirror down to 1-inch diameter and using a yellow filter just in front of the film (film speed the same as that of enlarging paper). We now take sun pictures with a wider aperture and a red filter at 1/10 second.

None of the pictures we are sending is really good, but we are very pleased with them as a starter and thought that other amateurs might be interested. I have tried to be brief and will welcome questions that might occur to others. But there are a few questions I should like answered, too.

Just a few days ago I located Neptune photographically quite easily, and would like to try for Pluto. Can someone tell me the magnitude and exact location? If it is much fainter than 14th, I wouldn't have much chance. Could you also advise me as to what one should get for a star atlas which would eventually be used with a 10-inch reflector? I have borrowed Webb's **Atlas** and find it within my means but rather brief on descriptive data and objects for study.

GEORGE ANDRUS
1638 East 1st St.
Albany, Ore.

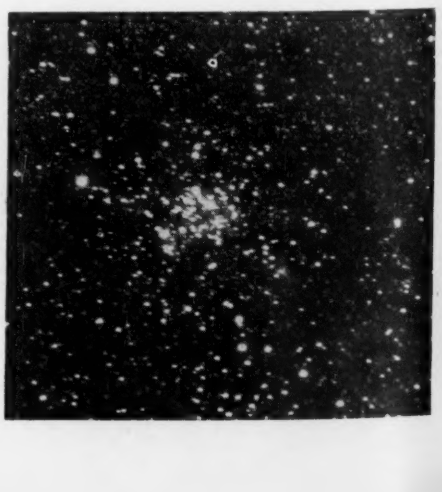
ED. NOTE: Pluto is too near the sun for observation now. Its position on May 1st was about $9^h\ 2^m.1$, $+24°\ 04'$, magnitude about 14. Later this year, the Nautical Almanac Office will probably issue an ephemeris for the 1947-1948 period of favorable opposition.

On February 19th last, we had the extreme pleasure of witnessing an unusually clear vista of winter stars. The enclosed enlargement from Kodak Super-Pan Press Type B film is of a picture taken with a Voigtlander camera having a Heliar lens, in my belief the best of the Voigtlander lenses. It is an f/3.5, with a focal length of 10.5 centimeters, and 2¼ x 3¼ cut-film holders. The enlarging paper is Ansco Brovira, contrast 4 to give more contrasty prints and show the fainter stars to advantage.

The camera was mounted on a tripod and pointed in the direction of the constellation we wished to trail, and we judge the exposure time to be about four minutes. I would like to be able to mount the camera on a clock drive so as to hold it steady on the stars, but I have no means of doing this. Perhaps one of your readers would help me with the problem.

With the help of Robert C. Ludden, I intend to make trails of all the brighter constellations as they appear in the sky.

FRANCIS E. ROWE
21 Main St.
Johnson City, N. Y.



George and Jerry Andrus took these star pictures with a 3-inch binocular lens, exposure times about one hour. At left is the Beehive in Cancer; at right the cluster M35 in Gemini.

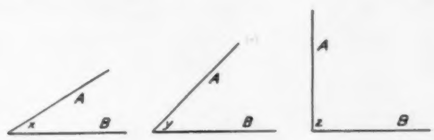
TERMINOLOGY TALKS - J. Hugh Pruett

Angles and Arcs

The watcher of the starry skies who cares to go beyond the simplest recognition and naming of the individual stars and their groupings will soon find that he should have some understanding of angles and their measurements. Those with geometry freshly in mind will have no trouble, but there are interested multitudes who have not yet had the opportunity for this study or when in school were not "mathematics majors." Work in tracing meteors for the American Meteor Society has indicated to me that few adults seem capable of estimating and stating angular distances in convenient units.

Formal definitions of the term *angle* vary in both the method of statement and the amount of confusion to the reader. It seems to be derived from the Latin *angulus,* meaning "corner." Perhaps an illustrated explanation rather than a definition will most easily show the meaning. Let us consider that the two lines *A* and *B* in the three figures below meet at the points just to the left of *x, y,* and *z*.

A is of the same length in all the figures — and so is *B* — but each figure

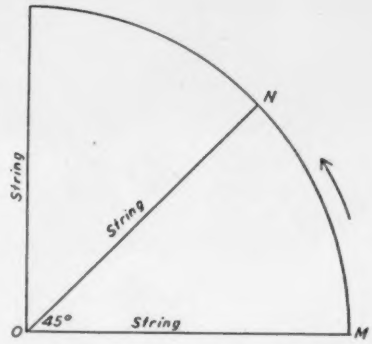


differs in the relative directions in which *A* meets *B*, or the amount of opening between them. The opening at *y* — shall we call it the *angle?* — is wider than at *x*, and the one at *z* is still wider. In mathematical language we may state that angle *z* is the greatest of the three and angle *x* is the least.

Since the figure forming angle *z* will fit around the corner of a square, we may call *z* a "square angle," or, as is more common, a ***right angle***. As we easily see that *y* is about one half a right angle and *x* one third, we are able to state roughly the sizes of these angles. However, it will be more convenient to state them in some smaller unit than in fractions of a right angle. The unit generally employed is one-ninetieth (1/90) of a right angle, a measurement designated as one *degree* (1°). Angle *z* is then 90°; angle *y*, 45°; and angle *x*, 30°.

Suppose we take a short piece of string, to one end of it attach an upright pin, and to the other end affix an upright pencil. Stick the pin into a smooth piece of wood at *O*, and then with the string taut move the pencil along so as to trace a curved line which will be a part of a circle — an *arc* of a circle.

Let *M* be the original location of the pencil point and *N* the first stopping point. The second position of the string makes an angle of 45° with its first position. We sometimes say that the arc *MN* is also 45°. Twice as great an arc, *MP*, one formed when the final position of the string makes an angle of 90° with its original position, has then a value of 90°. How many degrees will



there be in the arc if it is continued until a complete circle has been drawn? Four times 90°, or 360°; so we say that there are 360° in a circle.

The simplest application — and the least lofty — of this principle to the sky is in the number of degrees along the horizon, the place where earth and sky seem to meet for an observer on a wide, level plain. We may imagine a circle drawn entirely around this sky line. Its complete angular measurement is 360°. Should we start at the north point of the horizon and continue our curved line to the east point, a clockwise motion, the arc drawn will be 90°. Thus we say it is 90° from the north to the east, 180° to the south, and 270° to the west. (If we go counterclockwise from the north, it is then only 90° from north to west.)

As we trace up the sky itself, we easily see that it is 90° from the horizon to the zenith, the name of the point directly overhead. It is likewise another 90° from the zenith down to the opposite part of the horizon. It is then 180° from the northern horizon through the zenith to the southern horizon. This arc is one half a complete circle, the other half being invisible beneath the earth.

For finer divisions, the degree is subdivided into minutes (′) and the minutes into seconds (″). (A further subdivision of seconds into thirds (‴) has been used but is rarely heard of at present.) The table then reads:

$60'' = 1'$
$60' = 1°$
$360° = 1$ circle, or circumference.

Subdivisions of seconds are now expressed in decimals, such as $15''.17$. It would surely be easier in general if the finer units than degrees were all expressed as decimals of degrees; as for example, $20°\ 30'$ as $20°.5$. It is customary to place the decimal after the sign of the unit.

This system of angular measurement, known as the sexagesimal, seems to have been derived from the ancient Babylonian division of the year into 360 days. Since the sun seems to move eastward entirely around the sky among the fixed stars in a year, a degree is approximately its apparent angular movement each day.

LETTERS

Sir:

About the reversal of relief photographs, my experience with photomicrographs of metal surfaces is that anyone can see the bubbles right or reversed. The only thing to do is to imagine to one's self that the light strikes from the left or from the right side. Looking at the moon one knows from which side the light is coming and there is no reversal except in the case of seeing a small part of the moon when there is no limb or terminator, or for people who don't see the moon's image often enough.

Do you intend to publish also pictures of an earlier and later state of the moon? With my 8-inch homemade reflector I have made several moon pictures, but a moon diameter of 12 inches is the best I can produce, and so I would like having more Lick moon pictures. The back covers are of such good quality that I've made a set of lantern slides of them for a lecture; the halftone screen was not visible on projection.

Perhaps you can tell me whether or not there is a good book on the moon available, not too popular and which contains references on physical and selenological research of the last century? Also, one like Webb's **Celestial Objects for Common Telescopes,** which is out of print? I am a Dutch ATM.

D. A. BEEKHUIS
Lijsterbeslaan 95
Rijswijk (Z.H.), Holland

Sir:

It was interesting to note that I could not make the lunar photograph on the back cover of the April issue invert, since I could produce inversions of all the previous ones by causing the light to fall on the photograph in a direction opposite to that from which the light came originally.

A. E. HART
Murphysboro, Ill.

Sir:

On June 1st, at 9:00 p.m. Eastern daylight time, while making my routine hourly weather check, I noticed that the west limb of the gibbous moon, just south of Mare Crisium, was distorted; perceptibly but irregularly flattened, somewhat suggesting a phase effect. High, thin clouds produced a corona around the moon, but the moon itself was sharply distinct.

At first I was disposed to refer this effect

(Continued on page 17)

Meteor Problems and Photographs of the Perseids

BY FRED L. WHIPPLE, *Harvard College Observatory*

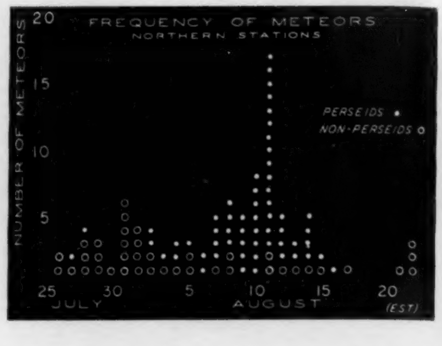
A typical Harvard meteor photograph.

MORE THAN 1,400 meteor trails have been recorded on Harvard photographs of the sky, with measurable trails of at least 1,000 individual meteors. The current program of analysis of these meteor photographs seeks to identify as many radiants as possible with relatively high precision; to determine the positions and daily motions of these radiants; to determine the cosmic spread of individual meteors from the mean radiants; to establish frequencies and dates of maxima, and to compare these with those obtained visually; to search for correlations of such characteristics as brightnesses, velocities, spectra, and the like; and to establish the relative proportion of sporadic to shower meteors.

It is hoped that such an analysis will provide observational data of sufficient interest to stimulate activity along theoretical lines in both celestial mechanics and astrophysics, for meteors represent our closest contact with the small particles of the universe, which are becoming increasingly important in cosmogony.

The precision of photographic measures makes the identification of meteors as shower members relatively simple and certain. In earlier work, Dr. Dorrit Hoffleit has shown that shower meteors constitute nearly half of 217 Harvard photographic meteors she studied. This fraction should increase as more meteors are studied and members of less conspicuous showers identified. The importance of this ratio in evolutionary theories of meteors, meteorites, and comets, can hardly be overestimated.

Comparison of photographic and visual determinations of shower radiants and of daily frequencies of shower meteors should provide clear evidence as to whether physical forces, such as light pressure or electric effects on charged particles, are appreciable in distributing meteoric particles about a mean orbit. As these effects may be expected to disturb smaller particles more than larger ones, the faint meteors should show systematic deviations in motion from the brighter meteors observed photographically. Observations by the writer of the Taurid and Geminid showers show no evidence of such deviations, but many more observations of this type are needed.

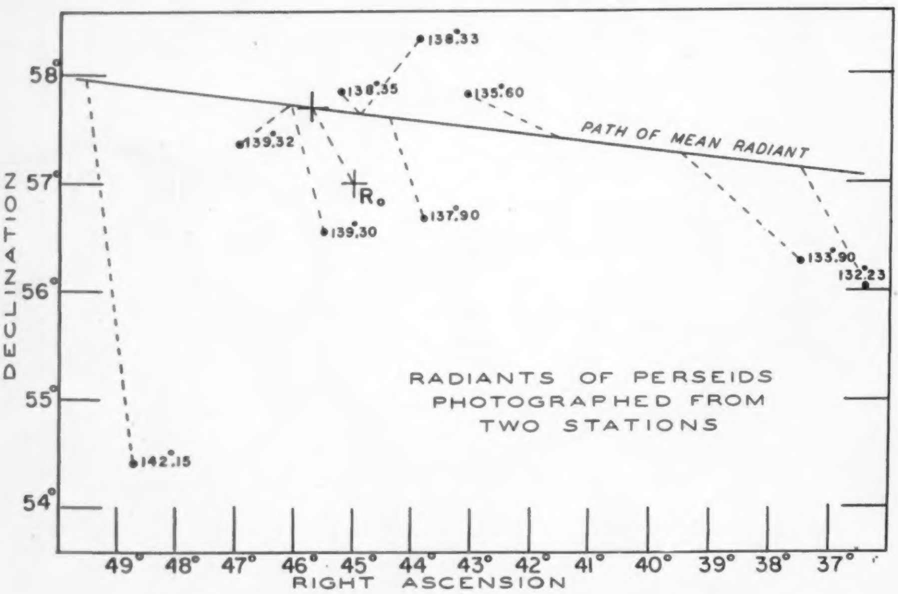


The frequency of meteors on Harvard photographs shows the peak of the Perseid shower very prominently.

Measures of the daily motions of radiants and the cosmic spread of the radiants for individual shower meteors will provide more grist for the mills of celestial mechanics. To date no theory adequately explains even the daily motion of the radiant for any shower, while no attempt has been made to utilize the information given by deviations in the directions of single meteors. Until such theories are established firmly, it will be impossible to determine the "ages" of meteor showers, or the dispersal rate of meteoric material along a comet orbit.

The analysis of Harvard meteor photographs has been completed only for the Taurid, Geminid, and Perseid showers. Miss Frances Wright is engaged in the measurements at the present time, although the results already published on the first two showers depend upon measures by the writer and other associates.

Careful plotting of single trails on charts leads to a surprisingly good determination of the great-circle motion of each meteor. Identification of shower meteors is made on the basis of the minimum distance that the great circle misses the preliminarily adopted mean radiant. For the Perseid shower, 49 single trails and nine doubly-photographed trails were accepted as Perseids. The frequency distribution with date is shown in the chart above for all of the meteors observed at our northern stations from July 25th to August 22nd. The Delta Aquarid shower of late July shows conspicuously. The acceptance of two Perseids as early as July 25th and 26th is questionable, but the frequency curve is distinctly asymmetrical, with "early" members. The maximum of the shower is on August 12th, in agreement with visual observations.



Each radiant is plotted for its actual position, but joined by a dotted line to the point on the mean path corresponding to the time the meteor was observed. Time is expressed in terms of the longitude of the sun, with 139° corresponding to August 12th, the date of maximum.

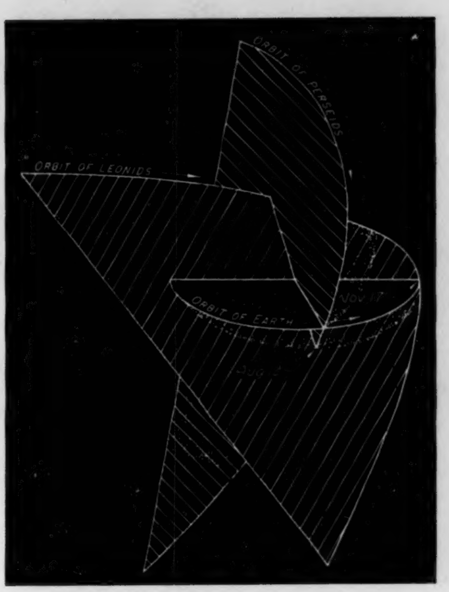
Of 76 (northern) meteors photographed in the interval from August 2nd to 22nd, inclusive, 56 are classified as Perseids, or 74 per cent, which is amazingly high. The maximum single deviation in radiant for an accepted Perseid from the least-squares solution for radiant motion (including corrections for zenith attraction and diurnal effect) is 197 minutes of arc. This is for a meteor photographed from two stations (doubly photographed) on August 15th. The graph on page 10 shows the radiants determined for eight double-station meteors as falling satisfactorily near a line representing uniform motion of the average radiant; only the meteor on August 15th (sun at longitude 142°.15) is discordant.

Extensions of single trails to the radiant area for singly photographed meteors, and the positions of the radiants for doubly photographed meteors, indicated the possibility of two moving radiants being in operation, the major one after August 7th, and a minor one before August 9th, with a possible third late radiant including the discordant meteor. But splitting the meteors into two groups, early and late, gave no more accurate solutions than obtained for one moving radiant without the division. More observations may well verify the apparent duplicity of radiant, but at present the all-embracing solution should be accepted.

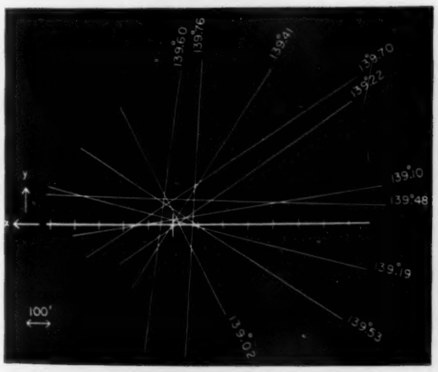
Comparison of the daily motions and residuals of the Perseids with the Taurids and Geminids brings out the fact that the Perseids are a much more diffuse meteor shower than the other two. Unpublished results indicate that the Giacobinids and Leonids represent extremely well-defined radiants whereas the Delta Aquarids are diffuse. Although the "age" of a meteor shower must play a part in producing a diffuse radiant, the perturbational and geometrical circumstances are of vital concern. With regard to daily motion of the radiant, these circumstances probably outweigh even the "age" in importance. The Geminids show the greatest daily motion of radiant, while the length of the shower is the shortest of the three. The Taurid and Perseid showers show a small and comparable daily motion, although the one represents an orbit of low inclination to the earth's orbit and the other a highly inclined orbit. These results indicate the need for detailed theory.

	Taurids	Geminids	Perseids
Geocentric velocity .. (km./sec.)	31	36.4	60.5
Inclination of orbit .	5°	23°	115°
R. A. of radiant	51°	112°	46°
Dec. of radiant	+15°	+32°	+58°
Daily motion in R. A.	+31′	+63′	+41′
Daily motion in Dec.	..	−4′	+5′

The cosmic spread of a projected single meteor trail from the mean predicted radiant at the instant is 43 minutes of arc (plus or minus). This is the probable error with reference to the center of gravity of the moving radiant, whereas the probable error of plotting the trail itself is only about seven minutes of arc near the radiant. The cosmic spread of the radiant for the Taurids is only 18 minutes; for the Geminids only 14 minutes. The significance of the much larger spread for the Perseids is not clear as yet.



The intersections of the orbit of the earth with the orbits of the August and November meteor swarms. From "Astronomy, Maps, and Weather," by C. C. Wylie.



At the time of maximum, the Perseids radiate from a relatively small area of the sky.

Predicted Positions of Perseid Radiant for 1947 by Frances W. Wright

Date (U. T. 0^h)	*R. A.*	*Dec.*
August 1	32°.3	+56°.8
4	35.8	57.0
7	39.3	57.2
10	42.7	57.5
11	43.9	57.6
12	45.1	57.7
13	46.3	57.7
16	49.8	58.0
19	53.3	58.2

SEISMOLOGISTS TRACK HURRICANES

In the *Bulletin* of the American Meteorological Society for February, 1947, an article by Marion H. Gilmore describes methods whereby recent hurricanes have been tracked by seismographs located at Roosevelt Roads, P.R., Guantanamo Bay, Cuba, and Richmond, Fla. The author is a geophysicist at the Navy Hurricane Weather Central, Naval Air Station, Miami. Extraordinary results have been obtained with seismometers in groups of three, each seismometer placed in a vault at the vertices of a triangle measuring 8,000 feet on a side. Regardless of the type of wave recorded, all possible directions of propagation will produce corresponding differentials in times of arrival at the three stations. From these time differences the direction in which a microseismic wave is traveling can always be calculated.

Hitherto, seismologists have considered possible the theory that the microseisms usually found in seismograph records were caused by heavy surf pounding on a steep coast. The experience with hurricane tracking indicated, however, that the microseisms were received too quickly from the storm centers to have been transmitted as waves to the nearest coast line. Although what produces the microseisms in a hurricane area is not known, it is believed that the energy is transmitted directly to the bottom of the ocean and then in the form of microseisms through the ground to the seismograph.

Seismographs proved more accurate in predicting the motion of the hurricane of June, 1945, as it passed over Florida, than did Army and Navy scout planes sent directly to the storm area. The amplitude of the microseisms recorded for a particular storm appears to depend principally on the storm's intensity and the distance from a recording seismograph, and to a less degree on other factors, such as the depth of the water over which the storm passes. The maximum effective distance a storm can be detected in the Caribbean Sea is about 600 miles, while in the Pacific Ocean it is at least 1,000 miles.

THE FOUR CASSINIS

For 125 years, from 1669 to 1794, Jean Dominique Cassini and his successors lived and worked at the Paris Observatory, their contributions to astronomy and geography closing only with the French revolution. For details in the story of this interesting family, see *Leaflet* No. 218, April, 1947, of the Astronomical Society of the Pacific. The first Cassini is famous for observing the division in Saturn's rings which bears his name, and for the discovery of four of that planet's satellites.

Amateur Astronomers

Amateur Astronomy in France

IN SUMMER, 1945, a group of young men in France organized a new society, "La Jeunesse Astronomique de France." The membership of persons 16 years of age and older has now reached over 500, chiefly students and young engineers. The stated purposes of the group are the diffusion of astronomy and science among French youth, advising amateurs, holding conferences, and "practical operations." They publish a 6-page bi-monthly bulletin containing articles suited to the astronomically inclined layman.

M. Donatien Cot, director of the French Bureau of Longitudes, has obtained for the group the use of a small observatory in Montsouris Park on the outskirts of Paris, equipped with 4-inch, 6-inch, and 9-inch refractors and some other instruments. As this observatory was badly in need of repairs, the Paris town authorities had promised to have it ready for use this summer.

While the French Board of Education has provided the society with funds equivalent to 50 dollars a month, it still feels hampered by financial difficulties. Books and journals are needed and additional instruments are desired. The members are obviously anxious to learn what is going on elsewhere in astronomy. Anyone interested in this new society or in helping it should communicate with M. Wladimir Chwetzoff, Courcelle (GIF), S. & O., France.

Another but much older group of astronomers (primarily amateurs) is likewise launching upon postwar activities. The president, M. Léonce Fabre, of the Société Scientifique Flammarion (founded 1884) at Marseille, has utilized the advertising facilities of *Sky and Telescope* to resume contact with book dealers, instrument makers, and the like. This society of adults sponsors lectures and courses in astronomy and general sciences, and it possesses a fine library. The members of the group appear very active. They have sent us abstracts of two papers on their current interests, one on a Cassegrainian mirror with spherical secondary, the other on the age of the universe.

As with the amateurs in Paris, the Marseille society is anxious to learn the progress of astronomy in the United States during and since the war, but it is not in a position to subscribe to many foreign journals. If anyone can send current scientific literature (in any subject, whether or not astronomical), it will be to the good of popular science. Address M. L. Fabre, 3 Rue Carnegie, Marseille, France.

Dorrit Hoffleit

Battle Creek News

The origin of the Battle Creek Amateur Astronomy Club, formally organized on November 1, 1946, goes all the way back to 1944, when E. H. Pilsworth solicited the aid of the Battle Creek newspaper in locating a comet which was in the sky at that time. Thereafter, the press showed such interest in amateur astronomy that with its help Mr. Pilsworth and others started a series of public astronomical activities which laid the foundations for the formation of the society.

As a member of the nearby Kalamazoo amateur astronomy club, the Battle Creek amateur became acquainted with a fellow townsman and amateur, Louis Vanpree, an expert on mirrors. Together they set up telescopes for public observations in the Leila Arboretum, where Mrs. W. V. Eichenlaub and her son and some other boys in his neighborhood were among those who had an opportunity to view the satellites of Jupiter, the rings of Saturn, and the moon. This started the young folks to meeting regularly to read books on astronomy, which activity they continued for a year and a half. Mrs. Eichenlaub writes:

"Then my son decided he wanted a telescope. We inquired about them, as well as we knew how at the time, but without success. Then one day he brought home a book on telescope making. From that we got the idea that possibly we could make one. We asked Mr. Pilsworth for help in ordering material and in making the instrument.

"Our society has a constitution and by-laws patterned after Kalamazoo's. We set our dues at one dollar for adults and 50 cents for children under 16 years of age. On June 10th we had 33 members, 15 of them ranging in age from 10 to 16."

In exchange for giving astronomy talks for school groups, the Battle Creek amateurs have the use of a fine museum building owned by the school board, where meetings of the nature club and the photographic society are also held. Mr. Pilsworth, now president of the society, an amateur who has traveled extensively in the Middle West and visited many other amateurs and groups, says,

"We have dreams of some kind of an observatory located near the museum building, where there are no lights to interfere, but it is still in town. The school board has this same dream, too, and we think we stand a good show of getting one."

THIS MONTH'S MEETINGS

Cincinnati: A star gaze and observation of the Perseid meteors will be conducted by the Cincinnati Astronomical Association on Tuesday, August 12th. Telescopes will be available and the public is invited. The group meets at Ault Park at the Observatory Avenue entrance. In the event of bad weather, the star gaze will be postponed to Friday, August 15th.

Indianapolis: Meeting at the Johnson Observatory on August 3rd, the Indiana Astronomical Society will hear a lecture entitled "Star Colors Tell."

New York: From August 29th to September 1st, the Amateur Astronomers Association will hold its annual weekend at Blue Mountain Reservation, Peekskill, N. Y. Registration is limited, and application should be made to the association secretary at the Hayden Planetarium.

Kalamazoo: Meeting at the home of Mr. and Mrs. Spencer Van Valkenburgh, 125 W. Washington, Vicksburg, on August 16th, the Kalamazoo Amateur Astronomy Association will hear a talk by William Persons on "Galaxies."

Pittsburgh: On Saturday, August 9th, the Amateur Astronomers Association of Pittsburgh will hold its annual picnic at Riverview Park, at the Bear Pit shelter. In the evening, the group will go to the Allegheny Observatory, also in Riverview Park, to observe with the 13-inch refractor.

Public Astronomy Class

Unusual interest in amateur astronomy has been aroused at Pasadena, Cal., this past school season by Fergus J. Wood, who served during the war as a captain in the meteorological service and who has been an instructor in physics at Pasadena Junior College since September, 1946. This institution has a splendid astronomical observatory, its largest telescope being a 20-inch reflector.

A class for townspeople was announced for each Wednesday evening from February to June, with hope for a group numbering at least 20 persons. At the first meeting 105 enrolled, and the number increased with subsequent sessions. The Pasadena *Star-News* gave considerable space to the growing class and its popular instructor.

This activity led radio station KWKW to ask Mr. Wood to put on a weekly 15-minute astronomical broadcast on the layman's level. Soon the Adult Education Commission of the State of California took over sponsorship of the radio program, which Mr. Wood calls "The Back-yard Astronomer."

Pittsburgh Elects Officers

The Amateur Astronomers Association of Pittsburgh has elected the following officers for the fiscal year 1947: Louis E. Bier, president; Edwin S. Hider, vice-president; James E. Brugh, secretary; Mary Burcik, treasurer.

NEWS NOTES

BY DORRIT HOFFLEIT

THE SURVEY FOR FAINT RED STARS

In the early 1930's, Dearborn Observatory began a survey of the northern 54 per cent of the sky for faint red stars: late *K* and *M* types and the *R* and *N* stars, or, respectively, titanium-oxide and carbon stars. That survey has now been completed. Totals of over 44,000 titanium-oxide and 200 carbon stars have been found, of which approximately half have just recently been published by Director Oliver J. Lee and his co-workers. The survey is presumably complete for all stars between magnitudes 5 and 12.

The distribution of the titanium-oxide stars as a whole appears to reflect the general structure of the Milky Way. Contrary to expectation, no high percentage of nearby faint dwarfs was found. Less than seven per cent, or 2,894, of the stars are late type, *M*5 to *M*9. These stars show a somewhat peculiar distribution, which leads the authors to conclude reluctantly that such stars are "especially abundant in our part of the galaxy, and that we have happened to appear upon the cosmic scene at a time when an unusual number of stars are passing through the titanium oxide stages in their development."

As for the carbon stars, the Dearborn observers confirm a "nest" of *N* stars noted previously by Mount Wilson observers, around galactic longitude 180 degrees, and they find a greater concentration of the *R* stars. In conclusion they again wonder if our branch of the Milky Way has an especial abundance of carbon characterizing the atmosphere of such stars; is this due to an irregular distribution of these cosmic materials; or is the age of this galactic subdivision appropriate to the times when stars are "racing" through the brief "carbon phase"?

ELECTRONIC CLEANING OF OPTICAL SURFACES

A new and efficient method for cleaning optical surfaces before they are aluminized has been announced by Bausch and Lomb Optical Company. This is especially important for television and telescope mirrors, where high precision of surface is required.

When glass is placed in a vacuum chamber, prior to aluminizing, a residue of moisture only several molecules thick always remains. While this can be removed by heat, aluminum will not adhere to a heated surface. The new method employs a hot tungsten filament which emits electrons (negative particles). The holder on which the mirror or glass rests is charged to a high positive voltage to attract the electrons. These bombard the glass at speeds of several thousand miles a second, and leave the mirror entirely free of water and other unwanted material. Only the surface of the glass is heated during the bombardment, but it cools almost instantaneously, allowing the aluminum coating to adhere perfectly.

BRUCE MEDAL TO LYOT

The 40th award of the Catherine Wolfe Bruce medal for distinguished services to astronomy has been made to Dr. Bernard Lyot, of Meudon Observatory, France, especially in recognition of his pioneering work with the coronagraph. With this instrument, he has successfully photographed the solar corona (without eclipse) from the Pic du Midi.

AMERICAN ASTRONOMICAL SOCIETY TO MEET

The 77th meeting of the American Astronomical Society will be held at Dearborn Observatory of Northwestern University, Evanston, Ill., September 3-6, 1947, on the invitation of Dr. Oliver J. Lee, director of the observatory. On Saturday, September 6th, a special session will be held at Yerkes Observatory, Williams Bay, Wis., in celebration of the 50th anniversary of the founding of the society and of the Yerkes Observatory.

Sessions for papers by members will be held on Thursday morning and afternoon and on Friday morning, with the business meeting scheduled for Thursday, and the teachers' conference for Friday afternoon.

SPECTRA OF A V-2

In an article "Research with Rockets," in the *Publications* of the Astronomical Society of the Pacific, Dr. Fritz Zwicky, of California Institute of Technology, describes some experiments carried out during the night firing of a German rocket on December 17, 1946, gives some spectroscopic results, and solicits the help of amateur astronomers for future work.

Using Wood replica gratings, Dr. Zwicky obtained spectra of the V-2 from launching to a height of about 3.5 miles with one camera, and spectra before and after the time of burnout (26 miles up) with another camera. Thus he has spectra both of the burning jet and of the luminous graphite rudders. The earlier spectra showed, in addition to the continuous spectrum of the jet, three emission bands near wave lengths 4713, 4937, and 5031, the first two of which are presumably due to carbon (C_2) and cyanogen (CN) molecules, respectively. The third band lies near bands due to S_2, CO, and N_2.

The other spectra, on panchromatic film, showed during burning additional bands in the red spectral regions. The spectra of the luminous rudders, after the rocket fuel cutoff, showed the continuous spectrum and an emission band at 6187 angstroms. "This means," says Dr. Zwicky, "that either C_2 or CN molecules evaporate from the graphite vanes and emit their characteristic bands. This opens up an interesting field for observation of the rate of evaporation of hot carbon and other substances high up in the atmosphere as well as the possibility of investigating the emission of certain forbidden lines if advantage is taken of the long mean free path in the tenuous upper atmosphere."

The California astronomer outlines plans for future experiments, especially on the shaped charges used for "artificial meteors." Such charges, exploded at various heights in the atmosphere, launched from airplanes, shells, balloons, and rockets, will require the co-operative efforts of many observers. "Amateur astronomers are therefore invited to participate in the experiments. Both photographic records with powerful cameras of large focal ratios and visual observations can contribute much toward successful realization of our program."

DR. GALLO RETIRES

Announcement has been made of the retirement of Dr. Joaquin Gallo as director of the Tacubaya Observatory in Mexico. Dr. Guido Munch is now in charge of the observatory.

WEATHER FROM RUSSIA

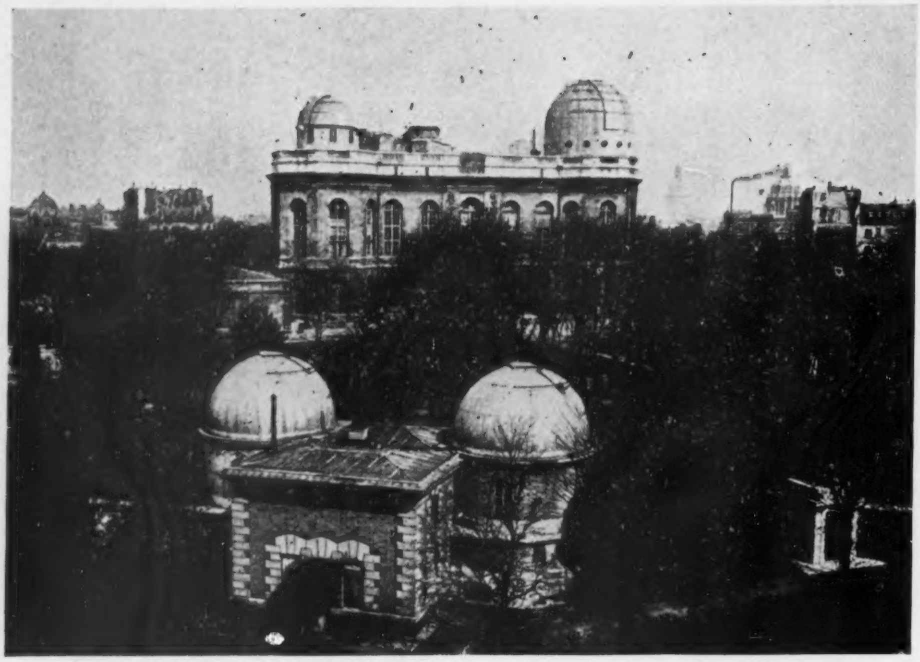
"Full and hearty co-operation from the Soviet Union is giving Americans better long-range weather forecasts," Science Service quotes Chief F. W. Reichelderfer of the U. S. Weather Bureau as stating. Weather data reaching the United States several times daily from Russia and Siberia are indispensable for accurate forecasting, since our own weather depends on conditions over the whole Northern Hemisphere, or even over the whole world.

In a planned exchange of experts, five Russian weathermen are expected to be in this country soon to begin studies with American meteorologists. Meanwhile, however, a shortage of meteorologists here prevents our sending any experts to Russia, but this may be possible to do after a meeting of the International Meteorological Organization in the fall.

METEORITICAL SOCIETY

Dr. C. C. Wylie, professor of astronomy at the State University of Iowa, Iowa City, has been appointed by the council of the Meteoritical Society to the directorship of the recently created meteor section of that society. Dr. Wylie is secretary of Section D of the AAAS and a former vice-president of the Meteoritical Society.

DRAMA



The Paris Observatory still stands on its original site, but many buildings have been added since the founding of this famous observatory in 1667.

THERE IS SOMETHING breathtaking in the view of a great observatory dome. Its imposing structure, towering against the background of a blue sky, is a scene well calculated to inspire the imagination. And anyone who surveys the complex maze of apparatus within such a dome is likely to experience mixed feelings of wonder and amazement. These are inspired by realization of the marvelous development of the modern telescope from its humble beginnings in the days of Galileo, plus knowledge of the many wonders that its magic eye reveals. A great telescope is like a window through which the astronomer explores the hidden depths of the universe. Or it might be thought of as a modern genie that brings the moon, planets, comets, and other celestial objects visually closer to the earth.

If one could turn the hands of time back more than three and a third centuries and visualize the world before the telescope was turned on the heavens, he would have an enlightening experience. At the start of the 17th century the world picture, as viewed by the great majority, was so different from ours that a modern mind would find it almost impossible to believe. Most of the universe as we picture it was unknown and even the more advanced philosophers never dreamed of the vast cosmos that every school child knows today.

While the famous heliocentric theory of Copernicus had been published for over half a century and was accepted by certain leaders of scientific thought, most people viewed it with doubts and openly expressed reservations. The authority of Ptolemy and his idea of an earth-centered system still claimed many advocates, since it seemed to be based upon sound observational evidence and also enjoyed the sanction of the church. Any theory that dislodged the earth from its all-important place in the scheme of things would quite naturally find hard going in those early days. Even Tycho Brahe, the greatest observational astronomer of the time, rejected the Copernican theory, although it is interesting to note that Kepler's laws of planetary motion, which later helped establish the new theory, were based largely on the records of Tycho's observations.

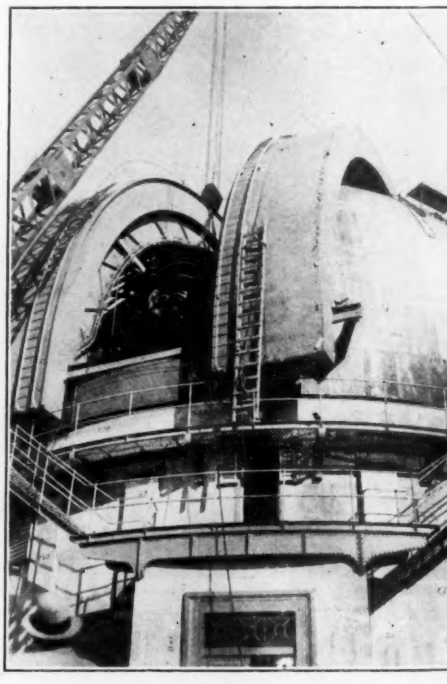
But in 1564 there was born in Pisa a genius whose name, Galileo Galilei, was destined to be listed among the immortals in the world of science. Of his many contributions to learning the one that concerns us here was the application of the telescope to the observation of celestial bodies in 1609.

Today we do not know with certainty who first discovered the principle of the telescope. It may have been Jan Lippershey, a spectacle-maker of Middleburg in the Netherlands. At least he is the one to whom many give the credit. But almost as soon as he applied for a patent others came forward to claim priority on the idea. Actually it is of little importance who invented the instrument. It was Galileo who in 1609 learned of its marvelous properties and immediately set out to make a telescope for himself. And it was also he who turned the telescope on the heavens and made the first of the great discoveries that have contributed so tremendously to our present ideas of the universe.

Galileo's first telescope was a very crude affair compared with even the simplest in operation today. Its magnification of three diameters offered little advantage over observations with the naked eye. Next, however, he constructed an instrument with a magnification of eight diameters, and finally one of 30 diameters. Even this most powerful of Galileo's telescopes was greatly inferior to the instruments used by most of our modern amateur astronomers. But the discoveries that he made are of inestimable importance.

Turning his new "optick tube" on the moon, he discovered the true character of its surface, noting its craters and mountains and comparing them with the rugged features of the earth. He observed sunspots and discovered that our daytime star turns on its axis. He found that the universe contains countless stars beyond the range of naked-eye visibility, and noted the true nature of the Milky Way. The planets were revealed as disks of appreciable diameter as compared with the stars, which remained as points of light although appearing much brighter than when observed with the unaided eye. He looked at Jupiter and discovered its four largest satellites revolving about it like a miniature planetary system. And when he focused his glass on Venus, he saw that it exhibited phases as does the moon. These observations provided strong evidence in support of the Copernican theory.

As we have noted, Galileo's telescopes



During construction of the David Dunlap Observatory, University of Toronto, the polar axis of the 74-inch reflecting telescope, largest such instrument in the Dominion of Canada, was lowered into the building through the slit.

F THE TELESCOPE

OBERT R. COLES, *Hayden Planetarium*

were relatively small and of limited magnifying power, because he used a concave lens for his eyepiece. This restricted the field of view seriously. He had shown the way, however, and before long others were experimenting with various types and combinations of lenses in an attempt to improve upon his idea.

One of those who noted the imperfections of Galileo's telescope was Johannes Kepler, who designed a telescope with a convex-lens eyepiece, to increase the field of view and permit greater magnification. While Kepler never made such an instrument himself, a professor of mathematics at Ingolstadt named Christopher Scheiner did build one which proved to be a great improvement. Another innovation that Scheiner added was the equatorial mounting, to make it possible for an observer to follow a star's diurnal motion across the sky.

But even the so-called Keplerian type of telescope was far from perfect. Although it provided a wider field of view than did the type used by Galileo, there were introduced the difficulties of spherical and chromatic aberration. The former is caused by the spherical shape of the lens, which results in a distorted image since all light of a parallel beam will not focus sharply at one point. The latter, chromatic aberration, results in an image that shows a fringe of color due to the prismatic action of the lens.

These problems were difficult of solution, and for many years astronomers had to content themselves with instruments that gave distorted and often varicolored images. Finally, in the year 1637, René Descartes, the famous French mathematician, explained the cause of spherical aberration and told how it might be avoided. He did not, however, understand the cause of chromatic aberration. The mysteries of the rainbow fringe were not explained until the days of Sir Isaac Newton, and it was not until past the middle of the 18th century that John Dollond solved the problem with achromatic lenses.

The methods that Descartes suggested for eliminating spherical aberration were to grind the lenses in a shape other than spherical, either elliptical or hyperboloidal, or to make lenses with as little curvature as possible. This latter meant increasing the focal length of the lens, which was by far the easiest solution at the time. Grinding lenses of other than spherical shape is difficult even now, and in those days it was practically out of the question.

As a result there began a contest of constructing larger and larger telescopes until some became so unwieldy that they were practically useless. One instrument made by Hevelius was 150 feet long, and others are said to have been even longer.

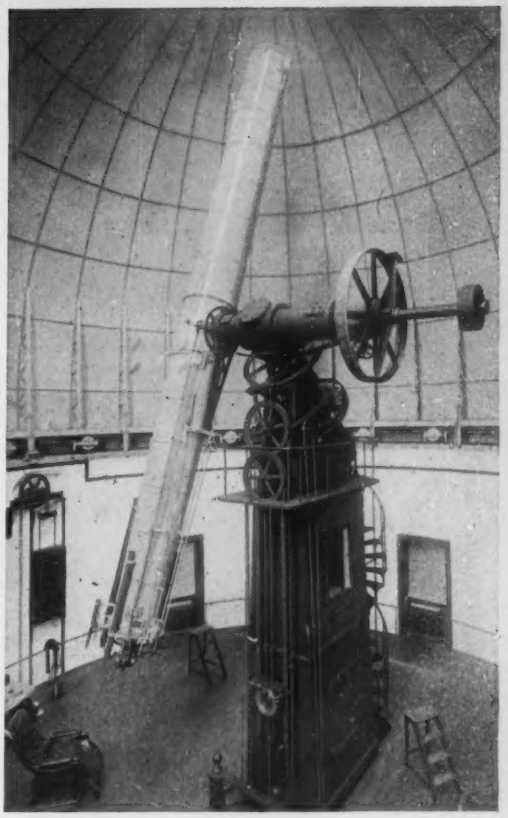
In 1655, the Dutch astronomer Christian Huygens, aided by his brother, Constantine, built a moderately large instrument through which the former discovered one of Saturn's satellites and then discovered the nature of its rings.

During the years that followed, the science of telescopic astronomy advanced with startling rapidity. In 1663, the Scottish mathematician, James Gregory, drew up plans for a reflecting telescope, and five years later Newton built a small reflector with a different arrangement of the secondary mirror. Here was a type of instrument that would practically eliminate the difficulty of chromatic aberration and one that was far less bulky than the great refractors then in operation.

While the reflector provided, in theory at least, a solution to many of the problems that beset the refractors of the day, the problem of grinding the metal mirrors then used was still an obstacle that kept that type of telescope out of general use for more than half a century. But by that time great progress had been made and there was a demand for the establishment of several large observatories. In the year 1667 the Observatory of Paris was founded, and the Royal Observatory at Greenwich, England, was established in 1675.

Along with the telescope, and of equal

(Continued on page 21)



Typical of many of the world's great refractors is the 26-inch at the United States Naval Observatory. With this instrument, in 1877, the satellites of Mars were first observed.

No small part of the drama of the telescope is in its appeal to young and old, and the never-ending interest amateurs have in making their own instruments. Drawing by Russell W. Porter.

BOOKS AND THE SKY

EXPLAINING THE ATOM

Selig Hecht. The Viking Press, New York, 1947. 205 pages. $2.75.

THE SECRET of the atom bomb is out. Five blinding holocausts of heat and radiation have given away the only important secret: that chain reactions are possible and can be created at will to form a bomb. Some of the techniques by which the various materials are handled during their isolation and purification are still heavily guarded, but they are relatively unimportant as they are only the methods devised in certain laboratories to overcome technical difficulties. Other men may find the same or simpler answers to the same questions.

"The real secret is that there is no basic secret." With these words, Professor Selig Hecht, renowned biophysicist at Columbia University, concludes his clear and deliberately brief book, **Explaining the Atom.** He was not associated with the Manhattan District or other groups working on the bomb. He knows no unrevealed secrets. His sources of information are available to everyone. Yet many who knew these same facts must envy the clarity with which they are presented in this book, where are outlined the series of experiments and theories by which our present concepts of atomic and nuclear structure have grown.

The gradual development of the observations, facts, and conceptual schemes underlying the control of atomic energy began at least as far back as Democritus, 400 B.C. However, not until the end of the 18th century, with the work of Lavoisier, Priestley, and Dalton, was chemistry organized into a pattern of ideas that is itself a chain reaction of experiments and theories suggesting more experiments and theories. The story really starts there and proceeds mainly in the field of chemistry until J. J. Thomson discovered the electron and Roentgen happened upon X-rays. The story of discoveries about atoms and their constitution continues down to 1936—when no one could have built an atomic bomb.

Yet only three years later, following the experiments of Hahn and Strassmann, which were further developed by Frisch and Meitner, the possibilities of releasing atomic energy under controlled conditions had become apparent to many. When the war broke, attention was shifted from further experimentation with atoms and their nuclei to the intricacies of manufacturing, if possible, an atomic bomb. Although Professor Hecht writes simply and without emotional tones, the suspense and tension that existed among atomic scientists during the crucial experiments on atomic piles permeate several chapters. The magnitude of the physical job of acquiring not micrograms, but literally pounds or tons of pure U-235 or plutonium staggers the reader, as it must have staggered those accepting the task.

Throughout, with carefully illustrated definitions, the reader is led to a grasp of modern atomic and nuclear theory. This is a primer, not a textbook, and much that could have been said is omitted. At times this brevity necessitates dogmatic statements of concepts that were long in developing. Yet these interesting points are incidental to the purposes of the book.

The author hopes "that this book will help to make intelligent voters." This he has tried to do by telling of the work of people in many countries over a period of at least 50 years. Atomic energy, **per se,** is no longer a scare headline, or the secret of only the United States, Great Britain, and Canada. What scares me, and I hope scares you, is the possibility that this great new source of energy available for creative application will, through international stupidity, fear, bluffing, and blundering, bring about the annihilation of our civilization.

FLETCHER G. WATSON
Harvard University

DIRECTORY OF ASTRONOMICAL OBSERVATORIES IN THE UNITED STATES

Compiled by **Mabel Sterns.** J. W. Edwards, Ann Arbor, Mich., 1947. 162 pages. $2.85.

IN THE PAST DECADE only a few listings of observatories have been available, most of which contained only the names of the principal observatories in professional use. Here a survey is presented listing some 300 observatories, both professional and amateur. It is efficiently cross-referenced. Listing by states is a splendid arrangement, as it enables one to make contact with an observatory in a desired section for some special project.

The book is divided into four parts: I, Observatories Other than Those of Astronomical Societies, 131 pages; II, Observatories of Astronomical Societies, 7 pages; III, Geographical List, 12 pages; IV, Observatories of the Near Future, 2 pages. There are 80 photographs of observatories distributed in 43 states. A supplementary map shows geographic locations.

In a brief perusal by the reviewer, it was possible to determine the states having the greatest number of observatories. California leads with 47; Ohio and Pennsylvania follow, each having 26; New York, 22; Massachusetts, 16; Wisconsin, 11.

First works of this kind are bound to have some omissions, but a second edition will alter this. It is felt that the author would welcome communications regarding corrections and omissions.

The book will be helpful to the professional astronomer as well as the amateur.

NEW BOOKS RECEIVED

HENRY THE NAVIGATOR, *Elaine Sanceau*, 1947, *Norton*. 318 pages. $3.50.

The story of one of the first of modern geographers and navigators, who operated a famous school of navigation and exploration.

EINSTEIN, HIS LIFE AND TIMES, *Philipp Frank*, 1947, *Knopf*. 298 pages. $4.50.

Einstein's successor at Prague, now teaching physics at Harvard University, presents the story of the great physicist's personal, scientific, and political experiences, based on a close friendship of long standing.

It should enable the former to evaluate the equipment of his amateur colleague, and it may call the amateur's attention to ways and means by which a fellow amateur has solved a puzzling problem or evolved equipment from materials at hand. It will also serve as a ready reference for those needing help with routine observations on a particular project.

NEAL J. HEINES
Solar Division, AAVSO

PANAMA EVENING SKIES

Oliver Bullock. Panama Canal Press, Mount Hope, Canal Zone, 1946. Unpaged. $1.00.

LATITUDE NINE DEGREES north, for which these star charts are drawn, crosses the Isthmus of Panama, where the author finds no previous maps which show the skies as seen from month to month. The charts are generally useful from the equator to about 20 degrees north, a zone which includes northern South America, most of Central America, central Africa, southern India, Ceylon, Thailand, French Indo-China, the Philippines, and many islands of the Pacific, including Guam and the Marshalls.

Mr. Bullock explains that these charts are simply copies of star maps made several years ago for his own use, but accurate enough to be of considerable value to the local observer. He gives tables showing which chart to use for any time of any night and for correcting the time of the chart for the observer's longitude.

Only the principal constellations are plotted, with names of the brightest stars. Below each chart is a brief discussion of the features of the sky for that month. This should enable the beginner in observing tropical skies to orient himself easily.

The author expresses the wish that the charts will "inspire some future Isthmian star gazer to make them obsolete by drawing a better set." Meanwhile, this publication fills an important need for the amateur who lives in the tropics.

In a recent letter, however, Mr. Bullock informs us that only a few copies of **Panama Evening Skies** are now available. But, he continues, "nothing would please me more than to know that my booklet is in active use in some of the far and near places on this earth. Therefore, I shall reserve 25 or 30 of the existing available copies in my possession for your readers ($1.00 per copy), preferably for those who live where the maps will be of greatest service — within 7½° of latitude 9° north. Until I notify the sender that a copy of the book is available, no money should be forwarded to me." Address the author at 3629 Menlo Ave., San Diego 5, Calif., U.S.A.

C. A. F.

ED. NOTE: Scarcely had the above been sent to the printer when there was received a set of star charts for the latitude of Hawaii, 20° north. These are apparently reprints in looseleaf form from a monthly series prepared by E. H. Bryan, Jr., for the Honolulu **Advertiser**, where Mr. Bryan may presumably be addressed.

These charts are suitable, of course, for observers around the world near latitude 20° north. They are well plotted and labeled, including stars of the 4th magnitude.

LETTERS

(Continued from page 9)

to the corona, but as steady gazing caused no change, I used binoculars, and then my 3-inch refractor, power 45x, which again confirmed the flattening. My wife also saw the phenomenon with the naked eye. The 3-inch showed that libration had brought Mare Smythii out well from the limb, a narrow line of limb being visible between the western edge of this mare and the edge of the moon. The flattening began in the northern hemisphere at a point on the limb, marked by a bright elevation, opposite Hansen, and continued into the southern hemisphere to a point on the limb opposite Langrenus.

Webb does not mention this flattening, though he describes a similar flattening farther south, beginning at Kastner (and which I did not see), and also mentions flattenings in 6° to 9° and 11°.5 to 18°.5 south latitude, which may possibly include these regions, though he does not further identify them.

In many years of close study of the moon, I have never before with the naked eye seen the limb perceptibly and irregularly flattened.

JAMES C. BARTLETT, JR.
Baltimore, Md.

Planetarium Notes

ADLER PLANETARIUM

900 E. Achsah Bond Drive, Chicago 5, Ill. Wabash 1428

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Tuesdays and Fridays, 8 p.m.; Sundays, 2:30 and 3:30 p.m.

STAFF: *Director,* Wagner Schlesinger. *Other lecturer:* Harry S. Everett.

August: AURORAS AND RAINBOWS. The northern lights, complex halos, and rainbows will be shown. Their causes and the color of the sky and of the setting sun will be explained.

September: AUTUMN SKIES.

BUHL PLANETARIUM

Federal and West Ohio Sts., Pittsburgh 12, Pa. Fairfax 4300

SCHEDULE: Mondays through Saturdays, 3 and 8:30 p.m.; Sundays and holidays, 3, 4, and 8:30 p.m.

STAFF: *Director,* Arthur L. Draper. *Other lecturers:* Nicholas E. Wagman, J. Frederick Kunze.

August: BY ROCKET TO THE MOON. An imaginary but eventful journey in a space ship of the future to view the moon's weird scenery, and with a safe return guaranteed.

September: MYSTERY OF THE NORTHERN LIGHTS.

FELS PLANETARIUM

20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Rittenhouse 3050

SCHEDULE: 3 and 8:30 p.m. daily except Mondays; also 2 p.m. on Saturdays, Sundays, and holidays. 11 a.m. Saturdays, Children's Hour (adults admitted).

STAFF: *Director,* Roy K. Marshall. *Other lecturers:* I. M. Levitt, William L. Fisher, Armand N. Spitz, Robert W. Neathery.

August: HEAVENS ABOVE! This is the story of the planetarium itself. The operation of the instrument will be demonstrated, and the way in which it accomplishes its effects will be explained.

September: TRIP TO THE MOON.

GRIFFITH PLANETARIUM

P. O. Box 9787, Los Feliz Station, Los Angeles 27, Cal., Olympia 1191

SCHEDULE: Wednesday and Thursday at 8:30 p.m. Friday, Saturday, and Sunday at 3 and 8:30 p.m. Extra show on Sunday at 4:15 p.m.

STAFF: *Director,* Dinsmore Alter. *Other lecturers:* C. H. Cleminshaw, George W. Bunton.

August: THE MOON AND THE CALENDAR. The story of our calendar, showing how the motions of the moon around the earth and of both around the sun have given us our year of 12 months.

September: GALAXIES.

HAYDEN PLANETARIUM

81st St. and Central Park West, New York 24, N. Y., Endicott 2-8500

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30 p.m.

STAFF: *Honorary Curator,* Clyde Fisher. *Chairman and Curator,* Gordon A. Atwater. *Other lecturers:* Robert R. Coles, Catharine E. Barry, Shirley I. Gale, Edward H. Preston.

August: DRAMA OF THE TELESCOPE. What are the tools the astronomer uses to explore the universe? See how these precision instruments reveal hidden wonders in the heavens.

September: A ROCKET TRIP AROUND THE WORLD.

GLEANINGS FOR A. T. M.s

A Rich-field Refracting Telescope

HANS PFLEUMER, of First Ave., R. R. 14, New Brunswick, N. J., has sent an account of his construction of an RFT refractor, together with a photograph on which he has numbered the important parts as described in his account, which follows:

The main features of this instrument are simplicity, stability, ability to observe the whole sky, and a quick change-over to use without the mount; by reason of the wing screws, the RFT may be removed for use for bird observation and similar purposes. The optical performance of the lens, which cost only $12.50, is good in the center, but with chromatic aberration rather noticeable around the rim of the field. The field takes in the Pointer stars easily, and I like the 'scope for open clusters and large nebulosities, but it is, of course, inferior to telescopes with higher magnifications for doubles and planets. The single eyepiece, giving 12-power magnification, was held sufficient optics. It appeared to me superfluous to equip a small RFT with circles, slow motion, and other doodads.

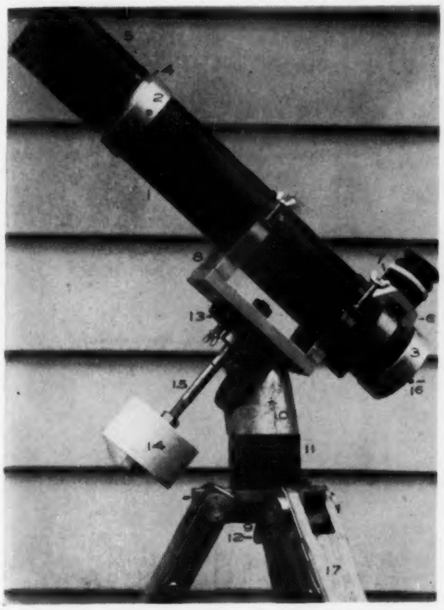
In the picture, 1 is a yellow bakelite tube 3½" outside diameter, 3¼" inside diameter, 17" long; 2, front aluminum ring; 3, back aluminum ring; 4, aluminum cell holding 2¾" achromatic aluminum-fluoride coated lens, 15" focus; 5, black bakelite dew cap screwed onto cell 4; 6, eyepiece mount block of aluminum strapped to 1; 7, a very large aluminum-fluoride coated achromatic eyepiece (focusing) with rubber relief cap; 8, aluminum saddle; 9, tripod head of laminated maple, legs and tenons are brass clad and reamed to accept ½" brass stud; 10, aluminum polar axis block 40½°; 11, laminated oak pad joining 9 and 10 by wing screw 12; bronze angle plate 13 connects 8 and 10; 14, bushed steel counterpoise on ½" threaded brass rod 15. The star diagonal, a large right-angle prism, is mounted internally under the eyepiece upon an aluminum block which can be collimated by stud 16.

About in the middle of tube 1 a stop is provided which is held in place from without by three countersunk screws. The inside of the shiny bakelite tube is lined with black blotting paper. Stud 16 has a hole in the end for turning the prism and can be clamped by a nut. Between 8 and 13, as well as between 10 and 13, heavy-walled steel rings, ½" high by 2⅞" outside diameter, pressed half way into the aluminum, serve as bearings. In addition, 10 carries a ½" steel stud reaching through 13 which is held to 10 by a castellated brass nut. It may be shimmed up for perfection. The other leg of angle plate 13 as well as the bottom plate of saddle 8 carry steel bushes reamed to fit rod 15. It can turn but there is no play. Rod 15 is collared and pinned on the side of angle 13 and tightened down by a castellated nut on the saddle side. A thin steel shim (0.001"-0.002") may be interposed between nut and bushing to regulate the cotter-pin holes in the end. In angle plate 13, furthermore, there are threaded in two wing screws (the ends of which have been flattened) pressing thin bakelite pads against 8 and 10 for brake action. For ordinary scanning, no tightening of them is necessary. The bearing surfaces are smeared over with "eyepiece grease" which provides just the proper resistance.

The use of the erecting prism is very convenient although the image is mirror-reversed, but this is not detrimental for astronomical purposes. A threaded metal cap is provided to protect the objective when the dew cap is removed. As it is impractical to cut threads onto the bakelite tubing, the aluminum rings were

tightly fitted to the squared-up tube and secured with six countersunk brass screws each. The hole under block 6 in the bakelite tube is somewhat oblong longitudinally to provide adjustment, as will be explained.

The oak legs 17 are 59" long — I believe in taking it standing upright as sitting down promotes laziness — and taper off toward the bottom ends in both dimensions. The lowest ends are trimmed down to octagon shape and provided with steel pins extending 1¼" for anchorage in the ground. When the tripod with 'scope is taken inside the legs are placed in a triangular frame (made from the remains ripped off the tapered legs) to prevent accidental kicking out a leg and consequent damage of the instrument. The wood parts were cut on a Delta 6 x 10 jointer saw and after hand-fitting the tenons varnished. Head 9 was joined by steel-doweling the three laminations; hot glue and hydraulic pressure were used. After that the tenons were wrapped with 3/64" brass sheet which was soldered together on the bottom. The brass pins and nuts joining the tripod were cut on the lathe to insure normal angles. The threads were kept tight so that once adjusted to tension they would not loosen up; with two special wrenches, however, they may be adjusted further. They are round for neatness.



The rich-field refracting telescope constructed by Hans Pfleumer.

The metal parts were all machined on a 12" Craftsman lathe. A good heavy angle to bolt to the face plate is necessary to machine 10, 13, and the internal prism block properly. The grooves for the steel bearing rings must fit the same on the outside exactly. On the inside there may be a little clearance. Care must be exercised after fitting 8 and 13 together to ream the contained bushings for accepting rod 15 together, that is, in different positions rotating 8 against 13. The two saddle pieces were machined out as one in order to fit the tube tight. Then they were

cut in halves, mounted on a short piece of tubing and the lower faces adjoining the plate were machined square. Finally, they were dowel-pinned and bolted by four countersunk steel screws. Block 10, angle 13, and the plate of 8 are punch marked so that vertical and horizontal positions can be readily found after the tripod platform has been leveled.

Very little aperture was sacrificed in mounting the lens in the cell, 1/64" all around being enough to hold the lens in place. The bearing surface of block 6 against tube 1 was machined on the lathe, as were the side faces, by holding it on the angle plate. The other four faces (to give it octagon appearance) were hack-sawed off and filed. The aluminum rings and blocks and the bronze angle plates were cast by a local foundry from my own enameled patterns. The saddle pieces were cut from solid ⅝ and ¾ aluminum plate. The counterweight was a piece of junk full of large holes which were plugged up and the whole finished in ivory. Aluminum castings cost 75 cents per pound, bronze 60 cents per pound; oak lumber (2 x 3) for tripod was three dollars. Bakelite tubing was a sample of several years ago and probably not manufactured any more; it is very true and sturdy. The eyepiece cost 15 dollars; the prism was three dollars.

In order to collimate the optical system, the following steps were taken. When ring 4 was machined four narrow grooves were engraved on the outside edge 90° apart (by means of the lathe dividing head). Black threads were laid across and fastened with Scotch tape. The eyepiece was removed and a special tube with adapter substituted. This tube is 5" long; 2¼" up is a stop with a 3/16" hole, and the top of the tube has a stop drilled with a No. 60 drill. The 'scope was directed against an illuminated sheet about 15 feet distant. When looking into the tube a small bright field was seen centered in a fainter one of twice the diameter. The collimating stud 16 was loosened and the prism turned to bring in the cross lines. By unclamping block 6 and shifting it longitudinally in the direction required, the horizontal cross line was centered, whereupon the vertical cross line was checked and the nut of stud 16 tightened.

The eyepiece is at such a distance from the primary that, when it is almost completely focused down, a shortsighted person's eye will see sharp at infinity. For objects 50 to 75 feet distant, the eyepiece must be completely focused out (¼"). If still nearer objects are to be observed, the lens cell can be unscrewed; it has a long thread and will bring objects as close as 25 feet into focus.

It is intended to use the primary with cell in a second tube as a camera, without prism but with a focal-plane shutter and filmholder. Furthermore, a third tube is to be used interposing an eyepiece and enlarging the image. The objective will then be used for focusing. But that is another story.

GLEANINGS is always ready to receive reports and pictures of amateur instruments and devices, and is open for comments, contributions, and questions from readers.

DRAMA OF THE TELESCOPE

(Continued from page 15)

importance in modern astronomical research, are the spectroscope, the photographic plate, and many other inventions that Galileo could never have pictured even in his wildest dreams. And important adjuncts to these optical and mechanical tools have been the developing sciences of mathematics, physics, and chemistry, for these have aided the astronomer in interpreting the facts his observations of the heavens have revealed.

Today there are large observatories located on favorable sites throughout the world. Several score in North America keep constant vigil of the near and far objects that populate the depths of space, and the 1947 *American Ephemeris* lists 224 active observatories in the world. Such names as Mount Wilson, McDonald Observatory, Oak Ridge, Yerkes, and Lick Observatory are only a few of the many that bring to mind the work of exploring the universe. And, of course, the great 200-inch reflector on Mount Palomar, in California, will soon be turned aloft to discover new wonders.

Not only have telescopes changed since Galileo's day, but the work of the astronomer has also changed. Today our modern star doctors have little time to sweep the heavens aimlessly, hoping for the chance discovery of some hitherto hidden object. Every observatory has a carefully prearranged program of activities with every hour taken up for some specific task. Some observatories specialize in determining proper motions and stellar parallaxes with long-focus telescopes. Others make spectrographic studies with large reflectors, or survey the extragalactic systems. A few use Schmidt-type telescopes to conduct star-counts and to study the matter between the stars. For although among professional astronomers the hobby of star-gazing has given way to the highly specialized fields of astrophysics, and the secrets of the cosmos are gradually being solved, the development of the telescope as the prime tool of astronomical research goes onward.

OBSERVER'S PAGE

Greenwich civil time is used unless otherwise noted.

The Visibility of the Moon

OUR NEAREST NEIGHBOR in space should be considered in regard to its visibility somewhat as the planets have been in previous issues.* For instance, one may well try to equal or better the observation of the youngest moon seen with the naked eye that I have been able to find a record of. On May 2, 1916, the moon was seen from Scarborough, England, when it was 14½ hours old. It was then in that part of its orbit about 5° above the ecliptic, the ascending node was in Aquarius (near the vernal equinox), and the ecliptic made nearly its greatest possible angle with the horizon, producing the latest possible setting.

My own record for seeing the moon is 19¾ hours after new, with slight optical aid. This was on December 8, 1942, when the sun was in Ophiuchus and the moon 9° to the east in Sagittarius. All conditions were again favorable: the moon was 5° above the ecliptic and north of the sun, and it was at perigee, 222,600 miles distant. I began looking for the moon right after sunset and found it 15 minutes later with 3-power binoculars. The illuminated portion was only 90° of arc and looked just a sliver of light. It set shortly after, when it could almost be seen with the naked eye.

Usually, if conditions are good, the moon first becomes noticeable to the naked eye 24 hours after new moon occurs. Less than this requires advance planning and careful observation. In one synodic month, 29½ days, the moon will be visible every night for 27 or 28 days, and at certain times may even be seen every day in a month, early in the morning before new on one day and the next evening after new. The best time for this would be in June, when the sun is in that part of the ecliptic that is "level" with respect to the equator. The moon should have its maximum northerly declination for northern observers, which from now on will occur with more favorable frequency during June to a most favorable situation in 1951. June is further favorable because the early sunrise and late sunset give the maximum time between observing the last crescent of the old moon and the first sliver of the new one.

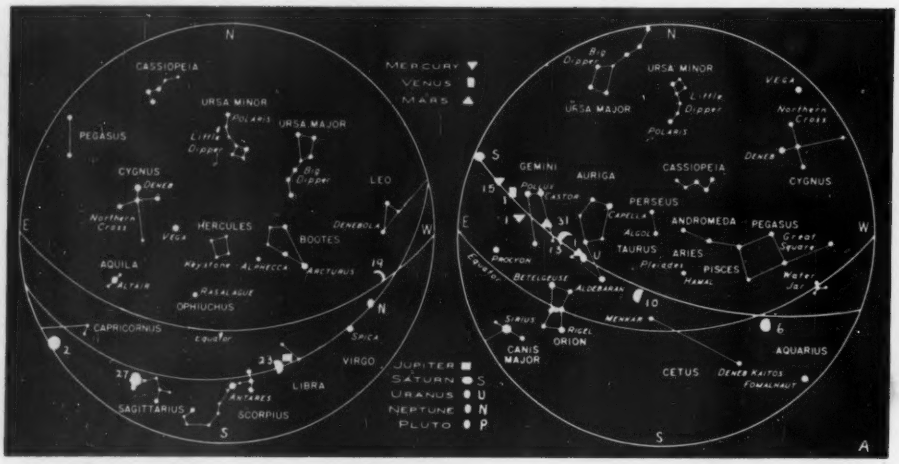
Previously mentioned planetary configurations* are true with the moon, only most are known by different terms, and the earth takes the place of the sun. Opposition and quadrature are full and quarter moons, and aphelion and perihelion become apogee and perigee. Additional phenomena to be considered are the regression of the moon's nodes, the movement of the line of apsides (perigee and apogee), and physical or apparent movements of the moon itself.

The moon's orbit is inclined about 5° 8′ to the ecliptic, and the points where it crosses the ecliptic are the ascending node (going north) and the descending node (going south). A cycle of regression of the nodes, westward around the ecliptic, takes a little under 19 years to complete. When the ascending node occurs with the autumnal equinox, as in 1941, the moon has its least range of declination during the month. Farthest north and south are then only 18° 19′ from the equator, giving a range of 36° 38′. The extreme and most noticeable range occurs with the ascending node at the vernal equinox (early in 1951), when the moon may change its meridian altitude by over 57° in 14 days. It may enter the constellation of Auriga at these times, for it can be 28° 35′ north of the celestial equator. From the latitude of New York, Luna may then be only 11° from the zenith, and from 61½° north, circumpolar for at least a day in the month. At present, the ascending node is in Taurus, with a longitude of about 60°.

Another motion is the eastward movement of the positions of the moon's apogee and perigee (farthest from and nearest to the earth), a complete cycle taking about nine years. Maximum and mini-

*Sky and Telescope, Observer's Page, "The Visibility of the Planets," June-September, 1946.

THE MOON AND PLANETS IN THE EVENING AND MORNING SKIES



In mid-northern latitudes, the sky appears as at the right at 5:30 a.m. local time on the 7th of the month, and at 4:30 a.m. on the 23rd. At the left is the sky for 7:30 p.m. on the 7th and 6:30 p.m. on the 23rd. The moon is shown for certain dates by symbols which give roughly its phase. Each planet has a special symbol, and is located for the middle of the month, unless otherwise marked. The sun is not shown, although at times it may be above the indicated horizon. Only the brightest stars are included, and the more conspicuous constellations.

Mercury, a morning star most of the month, reaches greatest eastern elongation on August 3rd. It is 19° 21′ west of the sun in longitude and rises 1½ hours before the sun. Its magnitude at elongation is +0.4, brighter than Castor and Pollux 10° to the north, but its brightness increases so the planet will be easier to locate after elongation. On the 16th of the month it rises one hour ahead of the sun, and is magnitude −1.1. The Graphic Time Table of the Heavens for 1947 (latitude 40° north) shows that for several days before and after superior conjunction on the 28th of August Mercury sets after and rises ahead of the sun.

Venus cannot be seen; superior conjunction is on September 3rd.

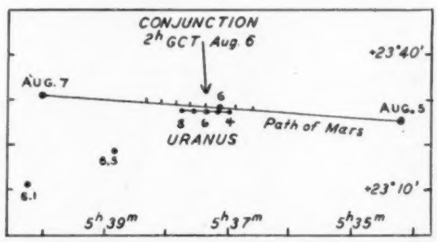
Mars, just barely a 1st-magnitude object, moves rapidly during the month from Taurus into Gemini. It is in the morning sky, and on the night of the 5th-6th it passes one minute of arc north of Uranus, a sight visible in opera glasses. (See diagram.)

Jupiter, magnitude −1.7, sets about 3½ hours after the sun. Eastern quadrature occurs on the 12th. During the daytime on August 22nd, the moon will pass close to the planet.

Saturn comes to conjunction with the sun on August 5th, but 21 days afterward it may be found with the naked eye. On the 26th the planet rises 1½ hours before the sun, and with a clear eastern horizon may be viewed about that date.

Uranus rises about four hours before the sun, with Mars very close to it on the night of the 5th. Its position on the 15th is $5^h\ 39^m$, +23° 29′ (1947) and the planet is 6th magnitude.

Neptune is too close to the sun for favorable observation. E. O.



This close conjunction of Uranus and Mars occurs before their rising for observers in the United States. By the time they are above the horizon, Mars will have moved considerably eastward, but with slight optical aid identification of Uranus will be quite definite, as only two other stars of comparable brightness are nearby. The marks on Mars' path show its motion in two hours.

mum distances are 252,710 and 221,463 miles. A full moon at perigee is 30 per cent brighter than at apogee, a noticeable difference. The apparent diameter of the moon varies between 33′ 30″ and 29′ 22″, and accounts in large measure for the duration of a solar eclipse and whether it will be annular or total.

The moon's brightness depends principally on its phase, with full moon generally stated to be nine times brighter than first quarter. This in turn is 20 per cent brighter than last quarter, because at last quarter there are more dark areas.

Earthshine is seen while the moon is in crescent phases, best about three to five days before and after new. In binoculars it may be seen for eight or nine days after new. There are variations in its brightness due to weather on the earth, and earthshine is stronger in the old moon because the portion of the moon with fewer seas is reflecting the light from the earth. The blueness of earthshine on the moon confirms the belief that our planet would appear as a blue "star" if seen from sufficiently far away.

The librations of the moon are the result of its own motions and those of the earth. In general, librations enable us to see more than half of the moon's surface, as much as a total of 59 per cent. In telescope or binoculars, librations may be observed by noting that features near the rim or limb of the moon appear to change their distance from the edge and may even disappear for a time. Detailed descriptions and explanations of the librations will be found in the more complete astronomical texts, such as Russell, Dugan, and Stewart's **Astronomy**, pages 169-170.

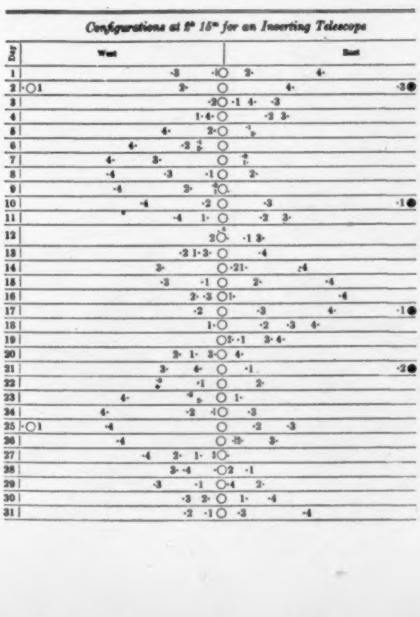
EDWARD ORAVEC

PHASES OF THE MOON

Full moon	August 2, 1:50
Last quarter	August 9, 20:22
New moon	August 16, 11:12
First quarter	August 23, 12:40
Full moon	August 31, 16:34

JUPITER'S SATELLITES

Jupiter's four bright moons have the positions shown below for the GCT given. The motion of each satellite is from the dot to the number designating it. Transits of satellites over Jupiter's disk are shown by open circles at the left, and eclipses and occultations by black disks at the right. Reproduced from the American Ephemeris and Nautical Almanac.



VARIABLE STAR MAXIMA

August 2, S Carinae, 5.7, 1006**61**; 2, RR Sagittarii, 6.6, 1949**29**; 7, Z Puppis, 7.9, 0728**20**b; 10, R Canum Venaticorum, 7.7, 134440a; 12, S Coronae Borealis, 7.5, 151731; 16, R Virginis, 6.9, 123307; 24, R Trianguli, 6.3, 023133.

September 1, R Cassiopeiae, 6.5, 235350; 2, RT Cygni, 7.4, 194048; 3, T Columbae, 7.6, 0515**33**; 3, R Carinae, 4.6, 0929**62**.

These predictions of variable star maxima are made by Leon Campbell, recorder of the AAVSO, Harvard College Observatory, Cambridge 38, Mass. Serious-minded observers interested in making regular telescopic observations of variable stars may write to Mr. Campbell for further information.

Only stars are included here whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0. Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

METEORS IN AUGUST*

August is known as the month for meteors. The finest display of the year comes from the Perseids, seen the first three weeks of the month. Many minor showers and the Delta Aquarids (maximum July 28th) contribute to make this month outstanding for meteor observation.

Perseid meteors may be seen from the first of the month to the 21st. High rates occur from the 9th to the 13th, with up to 70 meteors per hour visible at maximum in a clear moonless sky. The highest rates ever recorded were 189 per hour, in 1945 by R. J. Wood, as noted in **Popular Astronomy** for December, 1945.

The moon, fortunately, is at last quarter on the 9th of August, and although it will be in Taurus, south of the radiant during maximum of the shower, it will not seriously interfere. The radiant rises shortly after sunset in northern latitudes, but the shower should be best after midnight each night. One need not look directly at the radiant for best results; nearby regions in any direction will be more fruitful. Meteors from the shower will be seen, however, over the entire sky — the longer trails are usually farther from the radiant. Bright Perseids are frequent. The writer has seen a dozen brighter than Jupiter on a single night during the Perseid maximum.

Hourly counts and plots of this and other showers will be appreciated by the American Meteor Society, Flower Observatory, Upper Darby, Pa. Individuals should keep separate counts of all the meteors seen, regardless of duplications with others in an observing group. **Sky and Telescope** will be interested in publishing brief accounts of successful observations and photographs of this year's August meteors.

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*See page 11 for predictions of Perseid radiant positions from Harvard photographic data.—ED.

MINIMA OF ALGOL

August 2, 17:00; 5, 13:49; 8, 10:37; 11, 7:26; 14, 4:15; 17, 1:03; 19, 21:52; 22, 18:40; 25, 15:29; 28, 12:17; 31, 9:06. September 3, 5:54.

GREENWICH CIVIL TIME (GCT)

TIMES used on the Observer's Page are Greenwich civil or universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the GCT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown.

OCCULTATION PREDICTIONS

August 4-5 **336 B Aquarii** 6.5, 23:26.3 —9-33.5, 18, Em: **A** 9:34.0 —0.2 +1.8 191; **C** 9:25.9 —0.2 +2.2 188; **E** 9:16.7 —1.3 +1.2 220; **F** 8:51.2 —1.4 +2.0 212; **G** 8:46.2 —1.8 +0.8 273; **H** 8:19.4 —1.9 +1.3 259; **I** 8:28.6 —1.7 +1.0 282.

10-11 **53 Tauri** 5.4, 4:16.3 +21-00.9, 24, Em: **A** 5:51.5 +0.3 +1.7 233; **B** 5:56.8 +0.2 +1.6 238; **C** 5:47.2 +0.4 +1.6 232; **D** 5:55.4 +0.3 +1.5 241.

10-11 **247 B Tauri** 5.7, 4:24.9 +21-30.2, 24, Em: **G** 9:31.8 +0.1 +1.9 228; **H** 9:04.8 +0.6 +2.0 209; **I** 9:30.6 +0.2 +1.7 235.

22-23 **11 H Librae** 5.5, 15:29.6 —19-29.5, 7, Im: **F** 4:12.7 —1.1 —1.7 114; **G** 3:23.8 —1.4 —1.1 80; **H** 3:29.4 —2.0 —1.2 109.

September 7-8 **103 Tauri** 5.5, 5:04.9 +24-11.8, 23, Em: **A** 8:34.7 —1.1 +1.7 246; **B** 8:38.2 —1.2 +1.4 255; **C** 8:23.6 —1.0 +1.8 242; **D** 8:28.7 —1.1 +1.4 258; **E** 8:12.4 —0.8 +1.3 266; **F** 7:54.8 —0.4 +1.3 253.

For selected occultations (visible at three or more stations in the U. S. and Canada under fairly favorable conditions), these predictions give: evening-morning date, star name, magnitude, right ascension in hours and minutes and declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, GCT, a and b quantities in minutes, position angle; the same data for each standard station westward.

Longitudes and latitudes of standard stations are:

A +72°.5, +42°.5	**E** +91°.0, +40°.0
B +73°.6, +45°.6	**F** +98°.0, +30°.0
C +77°.1, +38°.9	**G** +114°.0, +50°.9
D +79°.4, +43°.7	**H** +120°.0, +36°.0
I +123°.1, +49°.5	

The a and b quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude respectively, enabling computation of fairly accurate times for one's local station (long. Lo, lat. L) within 200 or 300 miles of a standard station (long. LoS, lat. LS). Multiply a by the difference in longitude (Lo — LoS), and multiply b by the difference in latitude (L — LS), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Greenwich civil time to your own standard time.

For additional occultations consult the American Ephemeris and Nautical Almanac and the British Nautical Almanac, from which these predictions are taken. Texas predictions were computed by E. W. Woolard and Paul Herget.

In Focus

PLATE XVII of the series of lunar back-cover pictures is along the eastern limb of the moon, where most of the area is devoid of shadows because of the directness of the solar illumination at last quarter. Many of the identifications are somewhat uncertain, and on the accompanying chart these features have been indicated by dotted outlines. Portions of this plate appeared on Plates XIV and XV, and some features were discussed when those plates were printed. Identifications and spellings here follow the International Astronomical Union's **Named Lunar Formations,** by Blagg and Mueller. Biographical information is from the British Astronomical Association memoir, **Who's Who in the Moon.**

Billy. Described by Goodacre as a fine 31-mile ring plain, with a smooth dark interior, this feature is named for Jacques de Billy (1602-1679), a French Jesuit mathematician. He argued against the theory that comets move in straight lines, and strove to enlighten people from fear of comets and other astrological superstitions.

Cavendish. This crater is identified by the smaller crater in its southeastern wall. It is named for Henry Cavendish, 18th-century pioneer of modern chemistry and physics. He "weighed" the earth with his torsion balance.

Crueger. This 17th-century professor of mathematics and poetry at Danzig was the teacher of Hevelius. The interior of the crater is dark at all angles of illumination.

Doppelmayer. On the southeastern edge of Mare Humorum, this ring plain is half "submerged," but its central hill stands out noticeably. It is about 40 miles in diameter. Doppelmayer (1671-1750) was professor of mathematics at Nuremberg; he published a star atlas and a chart of the moon.

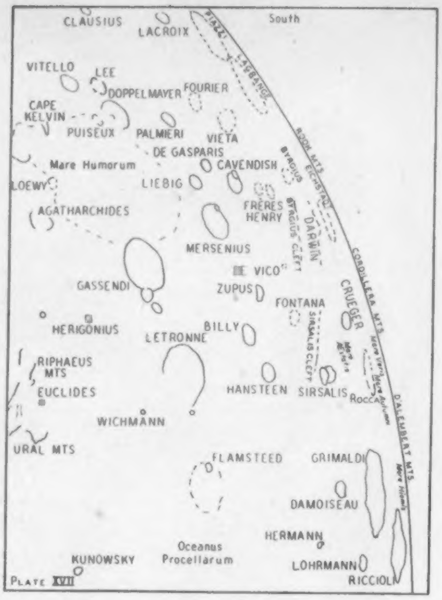
Flamsteed. The first Astronomer Royal has this small crater named for him. It stands inside a large enclosure with badly broken walls.

Grimaldi. Foreshortening makes this large formation seem smaller than it is. Goodacre estimates its diameter as 150 miles, although the I.A.U. gives only 97 miles. There are in addition 18 associated and designated formations. The floor of Grimaldi is reputed to be the darkest area on the moon. It was Grimaldi's map which Riccioli used to name features on the moon, and the formations bearing these astronomers' names are close together.

Hansteen. Compare this crater with nearby Billy, of about the same size. Christopher Hansteen was a famous 19th-century geodesist who discovered the position of the north magnetic pole and wrote on the aurora, meteor showers, and the solar corona.

Letronne. This is another large, almost obliterated ring plain. This French scientist was an authority on ancient Egyptian civilization, and in 1840 keeper of the French national archives.

Mersenius. A contemporary of Galileo and a fellow pupil of Descartes, Marin Mersenne taught theology in Paris. He corresponded with scientists everywhere, building Paris into Europe's intellectual center. He wrote on physics, chemistry,



astronomy, and experimented with parabolic reflectors. This lunar formation is marked by broad, terraced walls.

Oceanus Procellarum. The Ocean of Storms contributes considerably to the smoothness and darkness of the last-quarter moon.

Riccioli. Over 200 of Riccioli's lunar names are still in use, after about 300 years. Riccioli opposed the Copernican theory in favor of the Tychonic system. On this picture, the formation is almost impossible to outline exactly.

Rook Mountains. These mountains are often seen in profile on the limb of the moon, some peaks rising 25,000 feet, according to Goodacre. Lawrence Rooke (1622-1666) was a professor of astronomy at Gresham College. He observed Jupiter's satellites assiduously, even on the night of his death.

Zupus. This inconspicuous plain is named for the astronomer who may have been first to discern the belts of Jupiter, Giovanni Battista Zupi.

A CORRECTION — 22 AMERICANS ON THE MOON

Dr. Alice H. Farnsworth, of Mt Holyoke College, has called attention to the fact that 22 Americans, and not 20, are named on the moon. Two names must be added, therefore, to the list published in the June issue in the article by John W. Streeter.

Benjamin Peirce. In addition to Simon Newcomb, Neison named a formation shown on Plates II and IX for an American mathematician and astronomer, professor of mathematics and astronomy at Harvard in the middle of the 19th century.

Lewis Morris Rutherfurd. The French amateur astronomer, C. M. Gaudibert, who specialized in observing the moon, named a formation on Plate X after the American who devised and made the first lens for celestial photography. He took fine pictures of the moon and sun, and ruled diffraction gratings surpassed only by those of Rowland.

CONVENTION AT PHILADELPHIA

(Continued from page 5)

convention received a copy of *The Observer* for July, 1947, containing six one-column articles: The Franklin Institute, Amateur Astronomers of the Franklin Institute (publishers of *The Observer*), the Rittenhouse Astronomical Society, the Sproul Observatory of Swarthmore College, Astronomy at Haverford, and Flower Observatory, by Dr. Roy K. Marshall, E. F. Bailey, Harry B. Rumrill, Dr. Peter van de Kamp, Dr. L. C. Green, and Dr. Charles P. Olivier, respectively. Page 4 of the issue gave the convention program, on which the last event was the special demonstration of the Fels Planetarium Sunday morning.

Dr. Marshall demonstrated the operation of the Fels projector, and pointed out some of its limitations as well as its accomplishments. Accompanying that portion of his talk which concerned the mythology of the constellations was dreamy Liszt music. The Fels instrument looks "streamlined" as the small globes containing the projectors for the constellation names have been removed. The group photograph in the planetarium chamber caused lots of fun, as we draped and redraped ourselves around the projector.

The exhibit of instruments, photographs, charts, and gadgets by amateur astronomers was of high standard and required much time to be thoroughly appreciated. In charge of the exhibits was Mr. Bailey, and the judges were George V. Plachy, secretary, AAA of New York, Mr. Federer, and Mr. Spitz. First prize of 10 dollars was awarded to students of Mrs. R. M. Cole, Bryn Athyn, Pa., for an exhibit containing a model of the solar system (including the satellites), a star dial, an ecliptic star chart, and an insolation chart. Two second prizes, five dollars each, were awarded: George W. Clapp, Newtown Square, Pa., for a painting of Scorpius and Sagittarius from 28° north latitude; S. F. Thorpe, Louisville, Ky., for a 35-mm. camera adaptation to his telescope and a combined Foucault and Ronchi knife-edge tester. Three third prizes, two dollars each, went to John Stofan, Teaneck, N. J., Orion photograph; David Rotbart, Washington, D. C., meteor camera, and solar eclipse camera from Japanese machine gun camera; Milwaukee Astronomical Society, sidereal clock, double-slide plateholder, auroral photometer, and platecutting device.

Start planning your own exhibits now, in order to have a good showing next summer. Also, Mr. Halbach suggests that each organization member work on bringing a new society into the league now or before next year's convention. We'll be seeing you in Milwaukee, July 3, 1948, we trust.

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DEEP-SKY WONDERS

BETWEEN 18h and 19h the amateur will find about 14 globular clusters. Five of them bear Messier numbers. Their diameters range from 1.4′ to 17′; their integrated magnitudes from 3.6 to 10.2. But their brightness per unit area is more uniform. The entire list is given here, and the writer would like to know how many of these an amateur can succeed in locating.

M	NGC	18h	Dec.	Diam.	Mag.
	6541	00m	−43° 44′	6′.3	5.8
	6553	03	−25 56	1.7	10.0
	6569	07	−31 51	1.4	10.2
	6584	11	−52 15	2.5	8.3
	6624	17	−30 24	2	8.6
28	6626	18	−24 55	4.7	6.8
69	6637	25	−32 25	2.8	7.5
	6638	25	−25 34	1.4	9.2
	6652	29	−33 04	1.7	8.7
22	6656	30	−24 00	17.3	3.6
70	6681	37	−32 23	2.5	7.5
	6712	48	−08 50	2.1	9.9
54	6715	49	−30 36	2.1	7.1
	6723	53	−36 46	5.8	6.0

WALTER SCOTT HOUSTON

STARS FOR AUGUST

This chart shows the sky as it is seen from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of the month, respectively. The 40° north horizon is a solid circle; the others are circles, too, but dashed in part. When facing north, hold "North" at the bottom, and similarly for other directions. This is a stereographic projection, in which the flattened appearance of the sky itself is closely reproduced, without distortion.

EVENING STARS FOR SOUTHERN OBSERVERS

THIS CHART is prepared for a basic latitude of 30° south, but it may be used conveniently by observers 20 degrees on either side of that parallel. These southern charts appear in alternate months, but always two or three months in advance, to allow time for transmission to observers in any part of the world. The sky is here shown as it appears on Oct. 7th at 11 p.m., Oct. 23rd at 10 p.m., Nov. 7th and 23rd at 9 p.m. and 8 p.m., respectively. Times for other days vary similarly, four minutes earlier per day. These are local mean times which must be corrected for standard time differences. The 30° horizon is a solid circle; the other horizons are circles, too, those for 20° and 40° south being dashed in part. When facing south, hold "South" at the bottom, and similarly for other directions. Observers in the tropics may find north circumpolar stars on any of our northern star charts. For other charts in this series, see issues of alternate months from September, 1945, to July, 1946; and October, 1946, to the present.